ARI Research Note 89-41

Development of the AH-64A Display Symbology Training Module

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for

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To become fully qualified in the AH-64A attack helicopter, a student aviator must learn to identify and interpret the individual symbols presented on the helicopter's visual displays and to interpret the information provided by groups of symbols. This report describes work accomplished to develop a training module for teaching aviators to identify and interpret the symbology used on the AH-64A visual displays. The training module, known as the "Symbology Tutor," consists of an introductory section, a help system, and five lessons that provide instruction on the symbols contained in the AH-64A flight symbology set. The lessons cover symbols dealing with (a) position and movement, (b) attitude and altitude, (c) heading and navigation, (d) cueing and reference, and (e) weapons usage. Each lesson is divided into a tutorial and a quiz. Storyboards have been developed for each of the five lessons and are included in the appendixes of the report. Computer programs have been completed for the first two lessons. The report describes the completed portions of the Symbology Tutor and identifies the required computer hardware.

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DEVELOPMENT OF THE AH-64A DISPLAY SYMBOLOGY TRAINING MODULE

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ADSS	-	Air Data Sensor Subsystem
AGL	-	Above Ground Level
AH	-	Attack Helicopter
AQC	-	Aviator Qualification Course
ARIARDA	-	Army Research Institute Aviation Research and Development Activity
CMS	-	Combat Mission Simulator
CPG	-	Copilot/Gunner
CRT	-	Cathode Ray Tube
CWEPT	-	Cockpit Weapons and Emergency Procedures Trainer
EGA	-	Enhanced Graphics Adapter
FCC	-	Fire Control Computer
FLIR	-	Forward-Looking Infrared
HARS	-	Heading and Attitude Reference System
HMD	-	Helmet-Mounted Display
IERW	-	Initial Entry Rotary Wing
IHADSS	-	Integrated Helmet and Display Sighting System
LDNS	-	Lightweight Doppler Navigation System
LOAL	-	Lock-On-After-Launch
LOBL	-	Lock-On-Before-Launch
LOS	-	Line of Sight
PNVS	-	Pilot Night Vision System
SME	-	Subject Matter Expert
TADS	-	Target Acquisition and Detection System
TSTT	-	TADS Selected Task Trainer
VDU	-	Visual Display Unit

DEVELOPMENT OF THE AH-64A DISPLAY SYMBOLOGY TRAINING MODULE

Introduction

The AH-64A attack helicopter is a two-crewmember aircraft designed to fly nap-of-the-earth missions to detect, engage, and destroy enemy armor during day or night and under all weather conditions. To provide this capability, the AH-64A is equipped with several complex flight and weapons delivery systems. The successful operation of these systems requires that the pilot and copilot/gunner (CPG) be able to identify and interpret both visual imagery and symbolic information presented on visual displays.

The AH-64A visual display systems that provide information to the pilot and the CPG are the Pilot Night Vision System (PNVS) and the Target Acquisition and Detection System (TADS). The PNVS provides forward-looking infrared (FLIR) imagery that enables the pilot to fly the aircraft at night and during degraded visibility conditions. The TADS is used by the CPG for target search, detection, recognition, and designation. The TADS uses information from three sensors: the FLIR system, the day television viewing system, and the direct view optics system. These three sensors provide the CPG with visual information to detect and engage targets at standoff ranges during day or night operations and in adverse weather conditions. The Fire Control Symbol Generator superimposes flight and weapons symbology on the imagery displayed by the PNVS and the TADS.

The visual imagery and symbology from the PNVS and the TADS can be presented to the pilot on a 4.0" by 5.0" panel-mounted display or to the CPG on a 2.25" by 3.25" panel-mounted display. In addition, the imagery and symbology can be presented to either crewmember through the Helmet-Mounted Display (HMD), which consists of a 1-inch diameter CRT attached to the helmet. The HMD is a monocular display that enables the crewmember to cross-check flight and weapons information superimposed on infrared sensor imagery while directing attention outside the cockpit. All the displays provide the crewmember with a 30° (vertical) by 40° (horizontal) field of view.

<u>PNVS Symbology</u>

The PNVS symbology (flight symbology set) consists of the 27 alphanumeric and shape coded symbols shown in Figure 1. The symbols are designed to help the crewmember fly the aircraft. Not all the symbols shown in Figure 1 will appear on the displays at the same time. Many of the computer generated symbols are adaptations of traditional electro-mechanical instruments and are located in fixed positions on the displays (e.g., Heading Scale, Vertical Altitude Scale). Some, however, are unique dynamic representations of spatial information that move about the displays and in or out of the viewing areas as a result of sensor orientation or changes in aircraft position (e.g., Cued Line of Sight [LOS] Reticle, Hover Position Box).

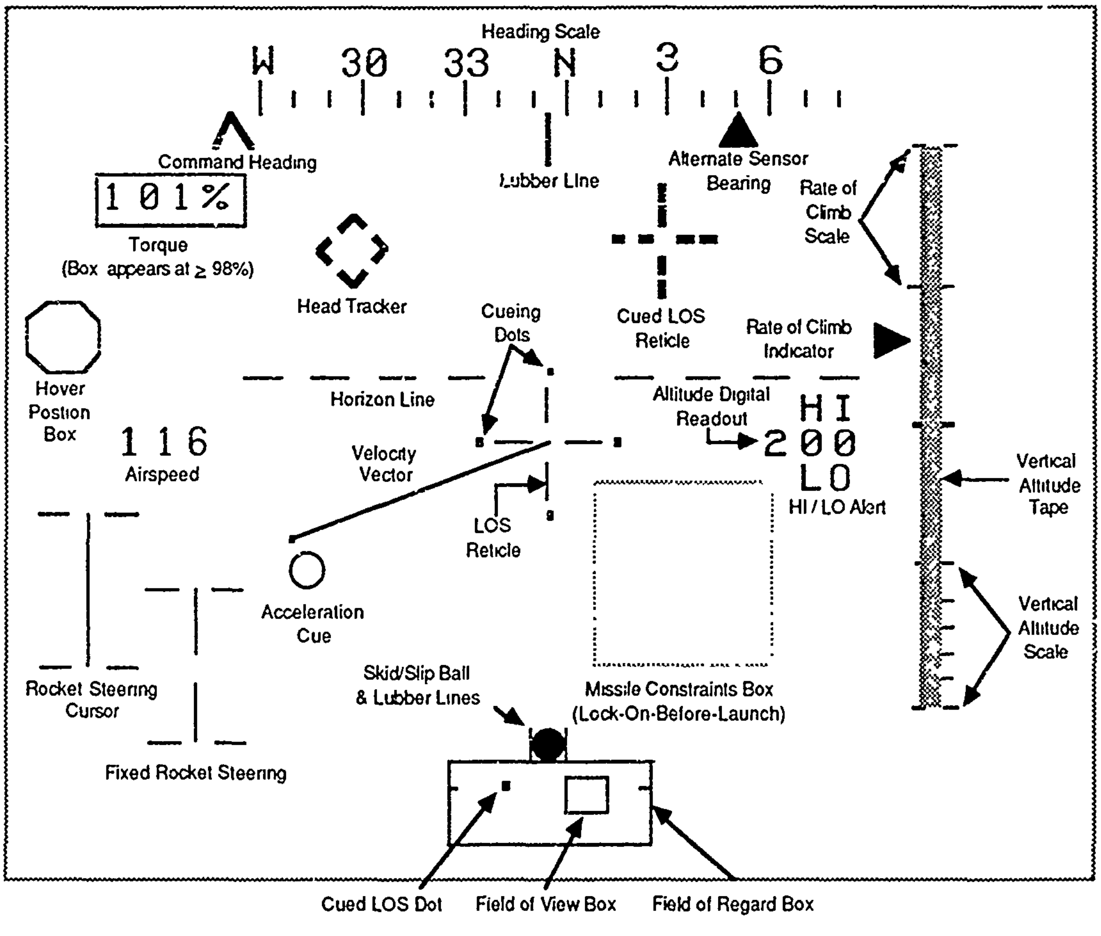


Figure 1. All of the symbols contained in the AH-64A flight symbology set (PNVS symbology).

To reduce clutter and to make the symbolic information more task specific, there are four operating modes that present subsets of the 27 symbols. Symbols representing aircraft heading, airspeed, altitude, engine torque, and certain other basic flight information are provided constantly during all four modes. The hover mode adds a velocity vector and an acceleration cue to aid the pilot in maintaining a hover. Selection of the transition mode adds a horizon line to the hover mode subset and is used when changing from a hover to cruise flight. Once cruise flight has been established, selection of the cruise mode removes the velocity vector and acceleration cue, adding only the horizon line to the basic symbology set. To aid the pilot in returning to a chosen location or remaining over the location with a specific heading, a bob-up mode adds the velocity vector, acceleration cue, command heading, and hover position symbols to the basic flight information.

TADS Symbology

The TADS symbology (weapons symbology set) consists of the 17 alphanumeric and shape coded symbols shown in Figure 2. Fourteen symbols are common to both the flight and weapons symbolology sets. The symbols are designed to assist the crewmember during the operation of the weapons systems. There is only one operating mode for the TADS symbology, but not all the symbols shown in Figure 2 will appear on the displays at the same time. The number of symbols displayed at any given time depends on the nature of the weapons tasks.

Training Process

To become fully qualified in the AH-64A attack helicopter, a student aviator must learn to identify and interpret the individual symbols presented on the helicopter's visual displays and to interpret the information provided by groups of symbols. During the AH-64 Aviator Qualification Course (AQC), student aviators are taught to use the symbology through classroom lectures, videotape presentations, self-study handouts, and technical manuals containing static diagrams of the symbology. Opportunities for additional practice with the display symbology are available on three training devices: (a) the TADS Selected Task Trainer (TSTT), (b) the Cockpit Weapons and Emergency Procedures Trainer (CWEPT), and (c) the Combat Mission Simulator (CMS).

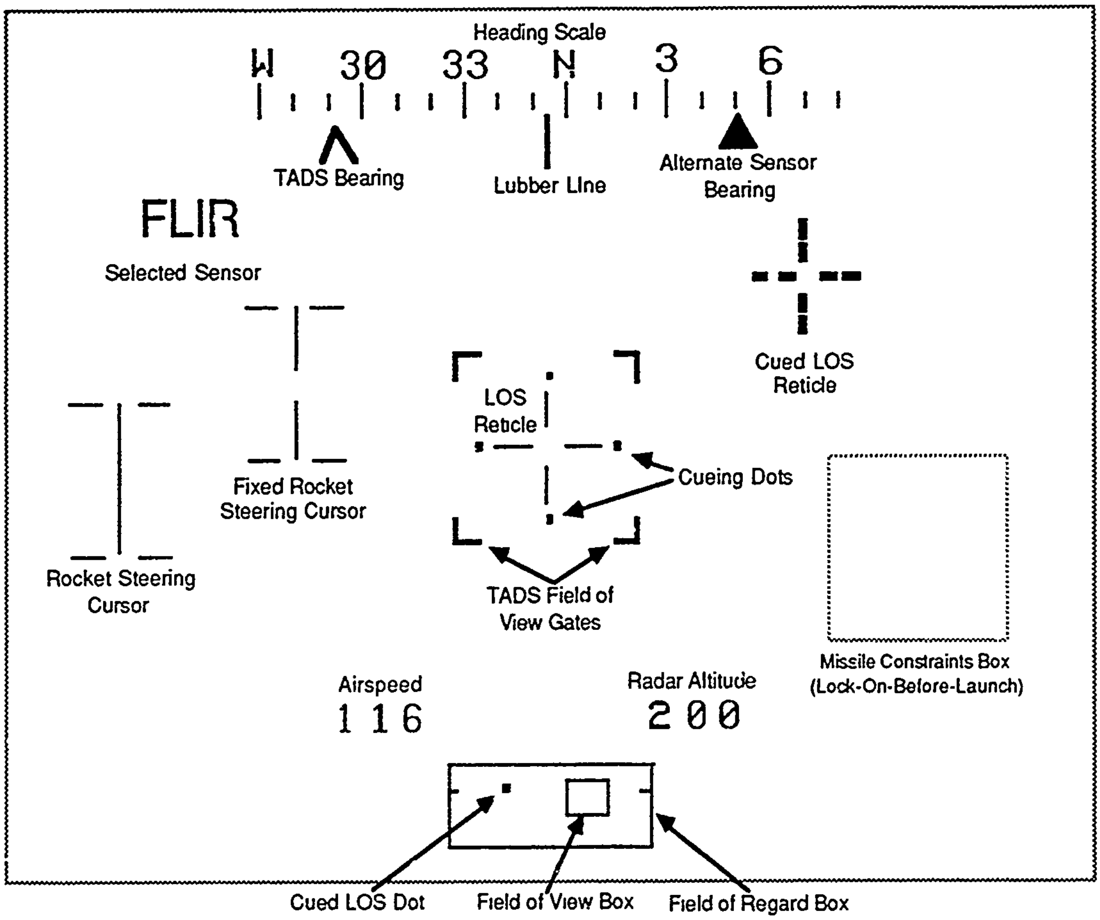


Figure 2. All of the symbols contained in the AH-64A weapons symbology set (TADS symbology).

The TSPT is a part-task trainer designed to support (a) initial CPG qualification and refresher training in the AH-64A and (b) TADS skill sustainment during mission and continuation training in operational aviation units. It provides practice only with weapons symbology. The CWEPT is a full-scale crew station procedures trainer. It is designed to provide training to the pilot and the CPG in both normal and emergency flight procedures and avionics equipment operation. The CMS is a six degree-of-freedom, motion-based simulator designed to simulate the flight and weapons capabilities of the AH-64A aircraft. It is currently used to provide training in combat mission scenarios during the Combat Skills phase of the AH-64 AQC and during operational aviation unit training. Both the CWEPT and the CMS provide the opportunity for practice with flight and weapons symbology.

Need

The training design features of the TSTT, CWEPT, and CMS do not include initial training on symbology identification and interpretation. Students assigned to training lessons on these devices are assumed to be familiar with flight and weapons symbology. However, TSTT, CWEPT, and CMS instructors report that they spend a large amount of time training basic symbology skills in these devices. Furthermore, students training in the TSTT, CWEPT, or CMS typically do not have opportunities to use the AH-64A display symbology under the full range of missions, modes, weapons, system options, and system failures. A device that provides specialized training in symbology identification and interpretation would improve the efficiency of TSTT, CWEPT, and CMS instruction. Therefore, the Training and Doctrine Command System Manager for the AH-64A requested that the Army Research Institute Aviation Research and Development Activity (ARIARDA) develop a training module for AH-64A flight and weapons symbology.

Project Objectives

ARIARDA established nine specific design objectives for the training module. The training module should:

- be designed in a self-instructional format (i.e., not require an instructor);
- be designed to provide training in a classroom setting;
- be designed to train symbology for the full range of aircraft mission and weapon system options;
- be capable of storing performance data and providing one or more performance indexes after each training exercise;
- be capable of providing immediate feedback and remedial instruction when errors occur;
- be suitable for both skill acquisition training in an institutional setting and skill sustainment training in an operational unit setting;
- be flexible enough to allow revisions resulting from (a) design changes in the aircraft, (b) design changes in the avionics system, or (c) deficiencies in the training module revealed by formal evaluation and feedback from the user;
- be designed to augment rather than replace existing training devices; and

- be economical in that it does not require the fabrication and use of mockups or other costly training aids.

Research Approach

Researchers at Anacapa Sciences, Inc., began work on the training module in December 1986. The researchers interviewed subject matter experts (SMEs) who were knowledgeable about the AH-64A display symbology. The SMEs included academic instructors from the AH-64 AQC, CWEPT instructors, and AH-64A instructor pilots. As a result of these interviews, it was concluded that performance deficiencies exist in the following areas:

- identifying and interpreting individual symbols presented alone,
- identifying and interpreting symbols in the context of other symbols,
- interpreting the meaning of symbology movement,
- correctly associating switch actions and control movements with static or dynamic symbology, and
- alternating attention between the display symbology and the external visual scene.

The researchers decided to organize the symbology training module into two parts. The objective of the first part of the training module is to address the first three performance deficiencies by providing skill acquisition training in symbol identification and interpretation for individual symbols and small, related subsets of symbols. The objective of the second part is to address the last two deficiencies by providing training in (a) correctly associating switch actions and control movements associated with the symbology and (b) alternating attention between the symbology and real-world and infrared visual imagery. After considering the project objectives, the training module design objectives established by ARIARDA, and the capabilities and limitations of existing training devices, the researchers concluded that the most appropriate medium for the training module was computer-based instruction.

Description of the Symbology Tutor

The Symbology Tutor is organized into three parts: (a) an introductory section, (b) a help system, and (c) five self-contained lessons. The introductory section provides the student with a brief orientation of the Symbology Tutor and contains instructions on how to use the program's features. The help system provides the student with on-line assistance for using the Symbology Tutor and for navigating through the program. Both the introductory section and the help system have been completed and will be described in a later section of the report.

Each of the five lessons consists of a tutorial section and a quiz section. Lessons have been developed only for the symbols in the flight symbology set. Time and resources were not available to develop lessons for the weapons symbology set. The contents of the five lessons are summarized in Table 1. Lesson 4 is divided into two parts. Lesson 4a (Central Cueing/Reference Symbols) covers symbols that appear in the center of the PNVS display (i.e., the Head Tracker, the Cueing Dots, and the Cued LOS Reticle). Lesson 4b (Peripheral Cueing/Reference Symbols) covers symbols that appear in the lower periphery of the display (i.e., the Field of Regard Box, the Field of View Box, and the Cued LOS Dot).

The portions of the Symbology Tutor that have been completed are listed below and are described in the sections that follow:

- a draft version of the storyboards for the tutorial and quiz sections of all five lessons; and
- computer programs for (a) the introductory section, (b) the help system, and (c) the tutorial and quiz sections for Lessons 1 and 2.

Storyboards

Prior to writing the programs for presenting the lessons on the computer, a storyboard was developed for each frame in the lesson tutorials and quizzes. The storyboards for Lessons 1 - 3 were reviewed by SMEs who were familiar with the AH-64A display symbology and by researchers and programmers who were knowledgeable about principles of computer-based instruction. Following the review, the storyboards were revised to incorporate the SME's comments. The storyboards for Lessons 4 and 5 have not been reviewed.

Table 1

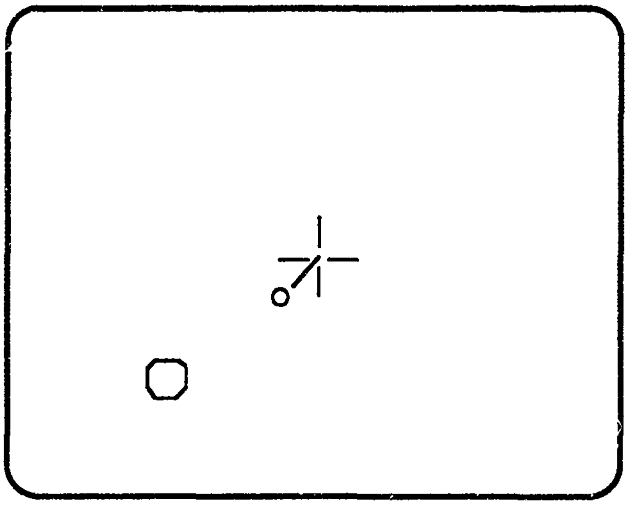
Symbology Tutor Lessons

Lesson Number	Lesson Name	Lesson Contents
1	Position/Movement Symbols	Line of Sight (LOS) Reticle Airspeed Digital Readout Velocity Vector Acceleration Cue Hover Position Box
2	Attitude/Altitude Symbols	Engine Torque Digital Readout Radar Altitude Digital Readout Radar Altitude Vertical Tape and Scale Rate of Climb Indicator and Scale Horizon Line Skid/Slip Ball and Skid/Slip Lubber Lines
3	Heading/Navigation Symbols	Heading Scale and Fixed Lubber Line Command Heading Alternate Sensor Bearing Horizon Line
4a	Central Cueing/ Reference Symbols	Head Tracker Cueing Dots Cued LOS Reticle
4b	Peripheral Cueing/ Reference Symbols	Field of Regard Box Field of View Box Cued LOS Dot
5	Weapons Usage Symbols	Cued LOS Reticle Rocket Steering Cursor Fixed Rocket Steering Cursor Missile Constraints Box (Lock-On-Before-Launch) Missile Constraints Box (Lock-On-After-Launch)

An example of a storyboard developed for a tutorial is shown in Figure 3. The starting location of the symbol to be covered in the instructional frame is shown on a facsimile of an AH-64A display, usually in the context of a reference symbol or symbols (e.g., the LOS Reticle). The instructional text that is to appear on the computer screen is shown in plain text below the display. Instructions to the programmer are shown above and below the display facsimile in bold italics and are enclosed by a double-line box. The programmer instructions for the tutorial frames indicate:

I-T26

The Hover Position Box is highlighted in green; Acceleration Cue and Velocity Vector are shown in yellow.



To fly back to the Hover Position Box, the pilot moves the cyclic aft and to the left so that the Acceleration Cue is located approximately halfway between the center of the LOS Reticle and the center of the Hover Position Box.

Press spacebar for demonstration.

Acceleration Cue, shown in yellow, moves to a position halfway between the LOS Reticle and the Hover Position Box. Velocity Vector extends to meet the Acceleration Cue.

Press spacebar to see demonstration again.

Figure 3. Example of a standard tutorial storyboard.

- what color to use for presenting each symbol,
- when to present supplementary information on the display that normally does not appear (e.g., numbers, arrows),
- what symbol flash rate is required,
- what symbol movement is required, and
- what supplementary text should be added following a student response.

Each tutorial storyboard has a unique identification code located in the upper right-hand corner (e.g., I-T1). The identification code consists of three parts: (a) a Roman numeral identifying the lesson number, (b) a capital "T" indicating that the storyboard is for a tutorial, and (c) an Arabic number identifying the sequence number of the storyboard within the tutorial.

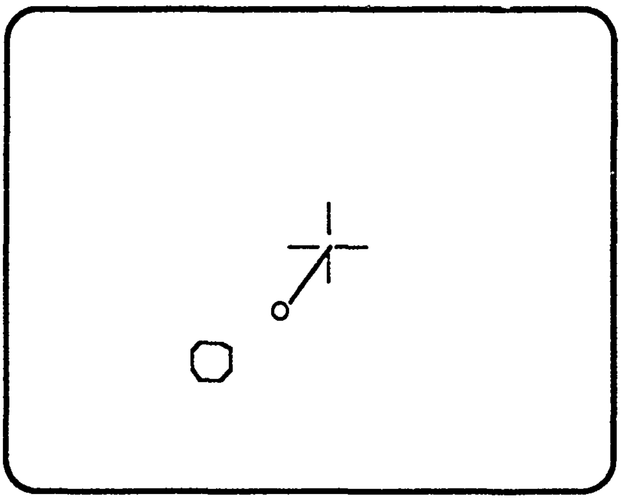
On some storyboards, a supplementary graphic is shown to the left or right of the panel-mounted display facsimile (see Figure 4). The supplementary graphic is added to illustrate (a) the relationship between the location or movement of a symbol and the location or movement of the helicopter (as shown in Figure 4), (b) the relationship between the location or movement of a symbol and the location or movement of the PNVS sensor, or (c) the appearance or disappearance of a symbol following the activation or deactivation of a control panel switch.

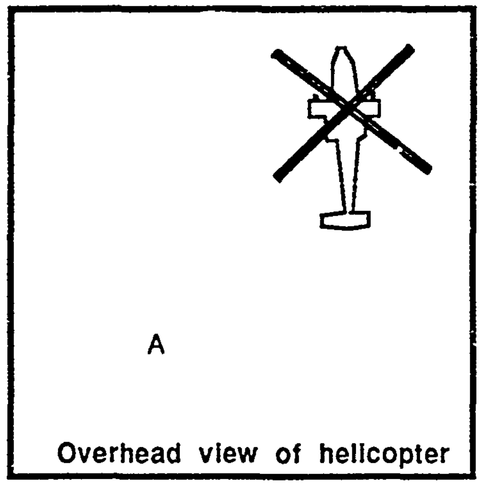
An example of a storyboard for a quiz is shown in Figure 5. The location of the symbol to be addressed in the quiz question is shown on a facsimile of an AH-64A display, usually in the context of a reference symbol or symbols (e.g., the LOS Reticle). The question that is to appear on the computer screen is shown in plain text below the display facsimile.

The instructions to the programmer for the quiz frames, shown in bold italics and surrounded by a double-line box, indicate:

- when to present a letter on the display (e.g., to identify a specific symbol),
- which response is correct, and
- which tutorial frames to branch to if the student makes an incorrect response.

The Hover Position Box is highlighted in green; Acceleration Cue and Velocity Vector are shown in yellow. Letter is not shown.





To return to the position the helicopter was in when the bob-up mode was initiated, the pilot flies the helicopter rearward and to the left. Then the Hover Position Box moves toward the LOS Reticle (representing the helicopter) on the display.

Press spacebar for demonstration.

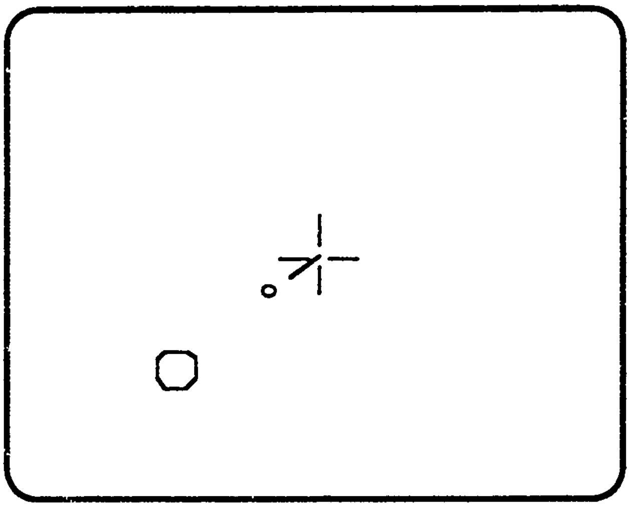
Hover Position Box moves upward and to the right until it is centered on the LOS Reticle. Acceleration Cue precedes Hover Position Box. Velocity Vector shortens and eventually disappears. Helicopter moves from present position to position "A". Acceleration Cue ends up centered in the LOS Reticle. Then add the following text:

Once the pilot returns to the position at which the bob-up mode was initiated, the Hover Position Box again is centered on the LOS Reticle.

Press spacebar to see demonstration again.

Figure 4. Example of a tutorial storyboard with a supplementary graphic.

I-Q18



According to the display shown above, what would the pilot do to return to the position at which the bob-up mode was selected?
1) keep the cyclic at its present position
2) move the cyclic so that the Acceleration Cue is halfway between the tip of the Velocity Vector and the Hover Position Box
3) move the cyclic so that the Acceleration Cue is in the center of the LOS Reticle
4) move the cyclic so that the Acceleration Cue is in the center of the Hover Position Box

Correct Answer = 2. If response = 1, 3, or 4, go to I-T26.

Figure 5. Example of a quiz storyboard.

Each quiz storyboard has a unique identification code located in the upper right-hand corner (e.g., I-Q1). The identification code consists of three parts: (a) a Roman numeral identifying the lesson number, (b) a capital "Q" indicating that the storyboard is for a quiz, and (c) an Arabic number identifying the sequence number of the storyboard within the quiz.

The storyboards for Lessons 1 - 5 are included as Appendixes A through E. The number of storyboards in the tutorial and quiz sections for each of the five lessons is shown in Table 2.

Table 2

Number of Storyboards in the Symbology Tutor Lessons

Lesson Number	Lesson Name	Number of Storyboards Tutorial	Number of Storyboards Quiz
1	Position/Movement Symbols	29	21
2	Attitude/Altitude Symbols	32	22
3	Heading/Navigation Symbols	25	21
4a	Central Cueing/Reference Symbols	25	17
4b	Peripheral Cueing/Reference Symbols	20	18
5	Weapons Usage Symbols	18	15

Computer Programs

Computer programs were written for the introductory section, the help system, and the tutorial and quiz sections of Lessons 1 and 2 of the Symbology Tutor. Both lessons were reviewed by two AH-64A CWEPT instructors and two AH-64A instructor pilots and were subsequently revised. The programs are described in the paragraphs that follow.

Introductory Section

The first two screens of the introductory section provide an introduction to the Symbology Tutor, state its purpose, and describe the contents of the five lessons (see Figures 6 and 7). Following this, two screens are presented that graphically depict and describe the parts of the computer keyboard that the student will use to access the help system, return to the main menu, view demonstrations of symbology movement, make menu selections, and navigate through the Symbology Tutor (see Figures 8 and 9). As shown in Figure 9, the keys that the students can use for navigating are listed in a status line located at the bottom of each screen.

The last screen in the introductory section presents the main menu options that the student can select to enter the help system, choose a lesson, or quit the Symbology Tutor (see Figure 10). The student selects the desired option by using the arrow keys on the computer keyboard numeric keypad to move a cross-shaped pointer to the appropriate box and pressing the ENTER key.

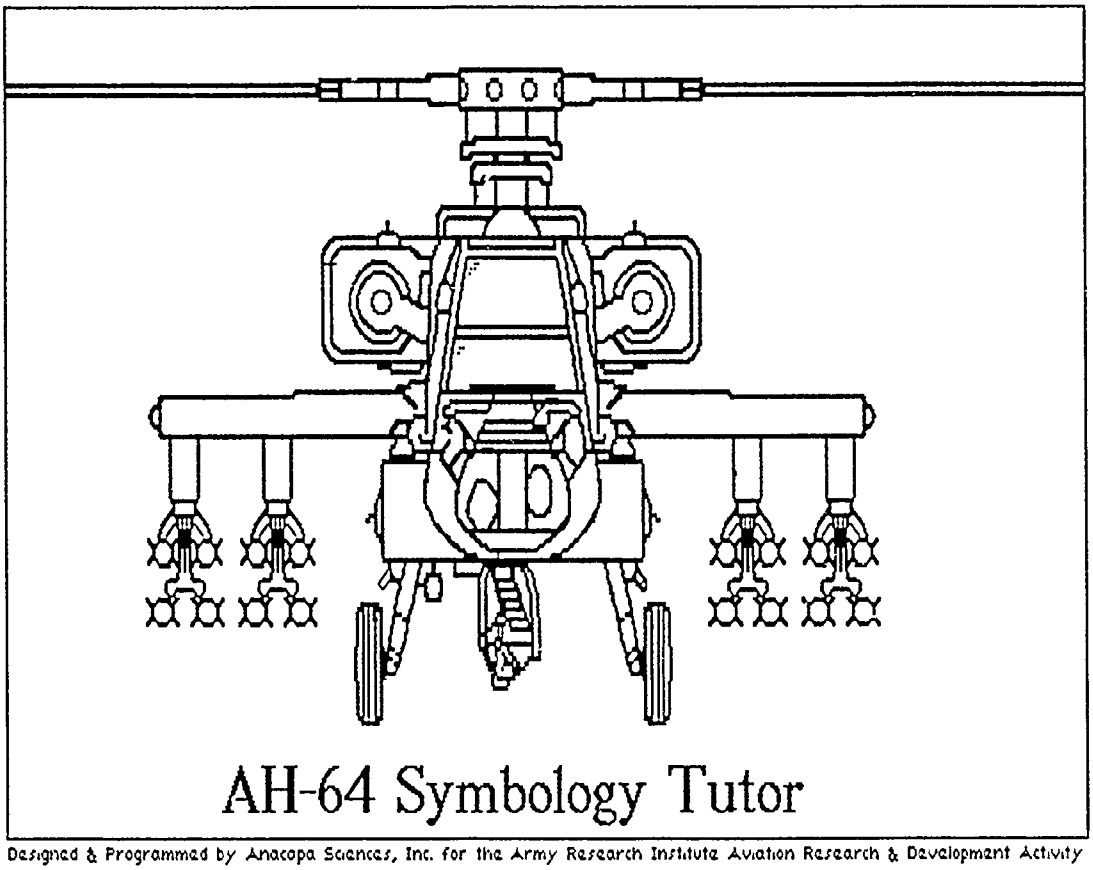


Figure 6. Opening screen in the introductory section.

AH-64 Symbology Tutor

Purpose

AH-64 Symbology Tutor is designed to teach you to identify and understand the meaning of the symbols in the AH-64 Flight Symbology set. This symbology is displayed both on the panel-mounted displays in the AH-64 and on the IHADSS unit (Integrated Helmet And Display Sight System). After using this program you should understand the basics of recognizing and interpreting AH-64 Flight Symbology.

Lessons

AH-64 Symbology Tutor is organized into five lessons. Each lesson covers a specific subset of the symbols in the AH-64 Symbology Set. The lessons are designed to be taken in order, i.e. Lesson 1 first, then Lesson 2, and so on. However, you may choose to view any lesson in any order you wish as best suits your training needs. The five lessons are:

Lesson 1 - Position/Movement Symbols
Lesson 2 - Attitude/Altitude Symbols
Lesson 3 - Heading/Navigation Symbols
Lesson 4 - Cueing/Reference Symbols
Lesson 5 - Weapons Usage Symbols

The next two screens will show you how to use the program's status line and how to use the keyboard. Then, you will go to the Main Menu to choose a lesson. Press the ENTER key now.

Press ENTER to go on to the next screen.

Figure 7. Screen describing the purpcse and contents of the Symbology Tutor.

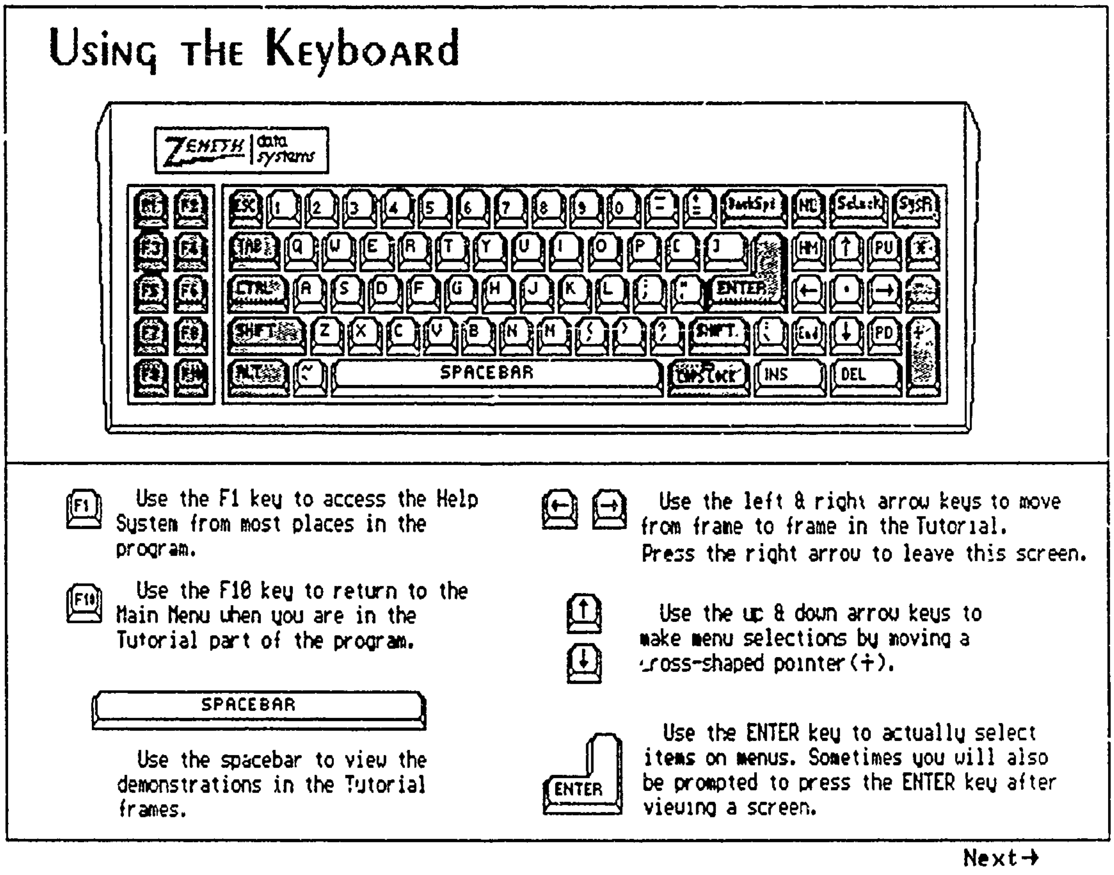


Figure 8. Screen describing the use of the computer keys.

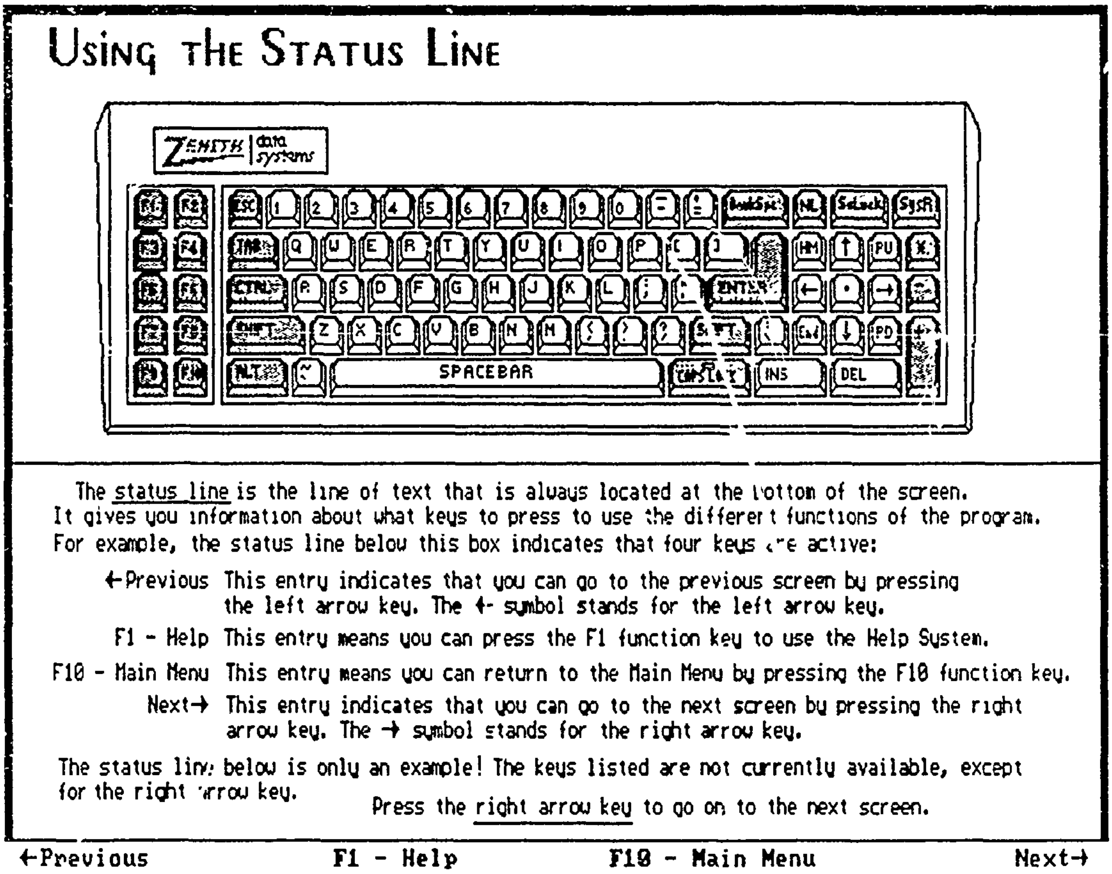


Figure 9. Screen describing the use of the status line.

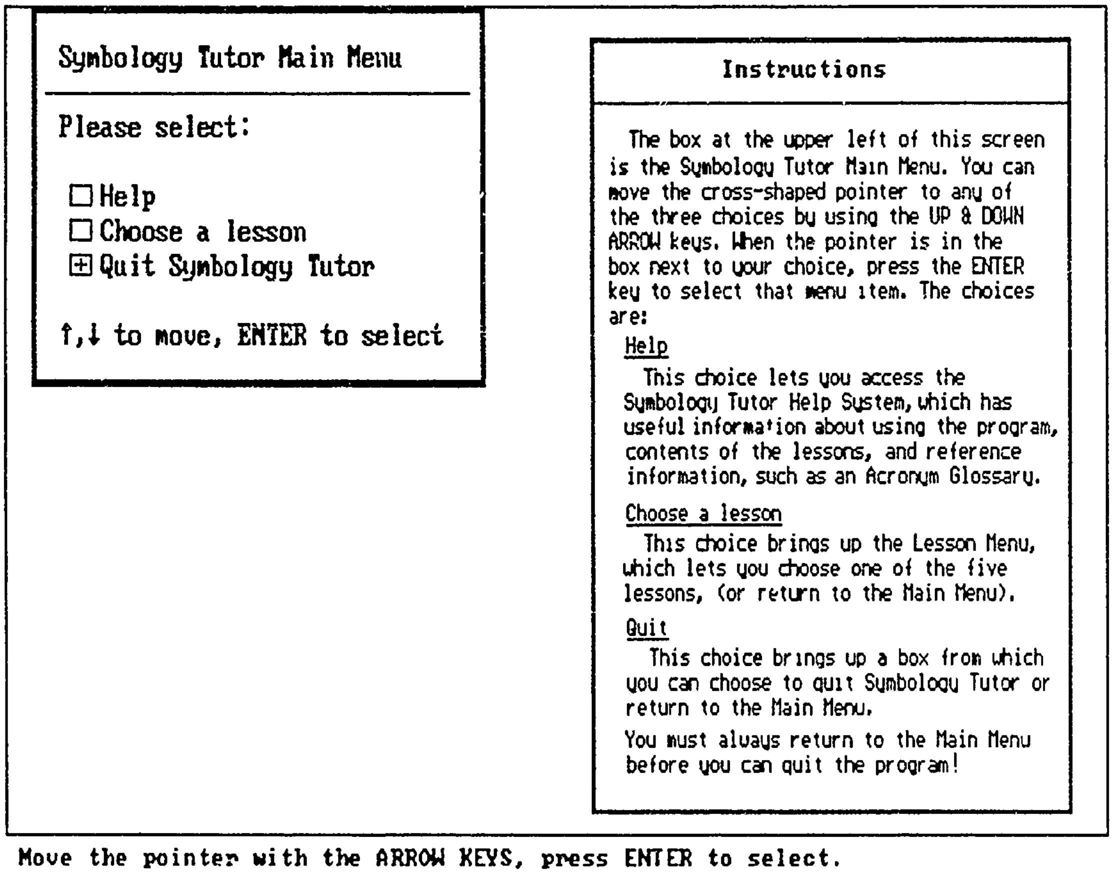


Figure 10. Screen showing the main menu options.

Help System

The help system, which provides the student with on-line assistance, can be accessed from any part of the program except the quiz. When the student selects the help options on the main menu, a window appears on the screen showing the help system options (see Figure 11). The parts of the help system are listed below:

- an overview of the training module;
- an explanation of the types of help provided (e.g., procedural and content);
- a list of the contents of each of the five lessons in the training module; and
- a reference subsection consisting of (a) an acronym glossary, (b) a symbology mode dictionary, and (c) a symbol dictionary (see Figure 12).

The symbology mode dictionary and the symbol dictionary are briefly described in the following paragraphs.

Symbology mode dictionary. The symbology mode dictionary consists of four screens, one for each of the four AH-64A symbology modes (i.e., hover, transition, cruise, and bob-up). An example of a screen from the symbology mode dictionary is shown in Figure 13. Each screen lists the name of the symbology mode, states the purpose of the mode, and shows a graphic representation of the symbols that appear in that mode. Symbols that are specific to that symbology mode are shown in green on the computer screen and the remaining symbols are shown in white.

Symbol dictionary. The symbol dictionary consists of 27 screens, one screen for each symbol covered in the flight symbology set. An example of a screen from the symbol dictionary is shown in Figure 14. Each screen shows:

- the symbol's name,
- the symbology modes in which the symbol appears,
- the purpose of the symbol,
- the failure actions associated with the symbol,
- the tutorial lessons in which the symbols are presented, and
- a graphic representation of the symbol in the context of one or more reference symbols.

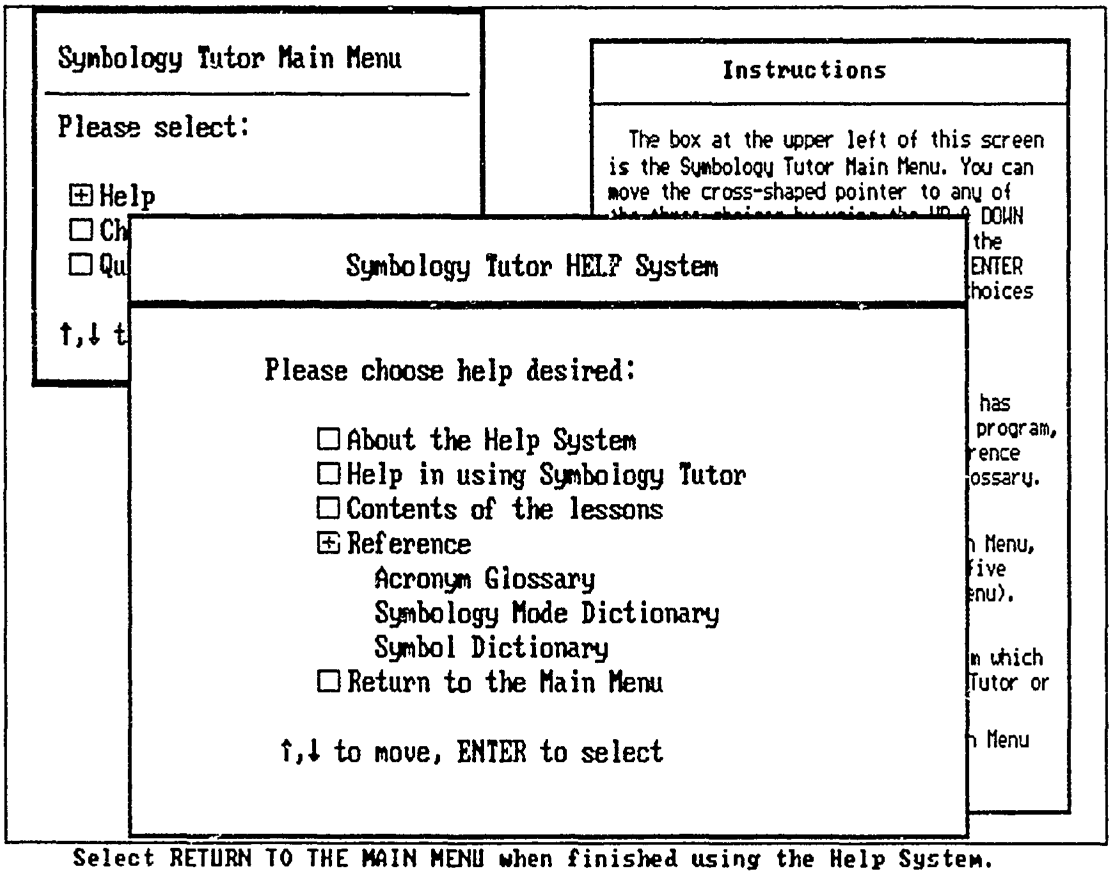


Figure 11. Screen showing the help system options.

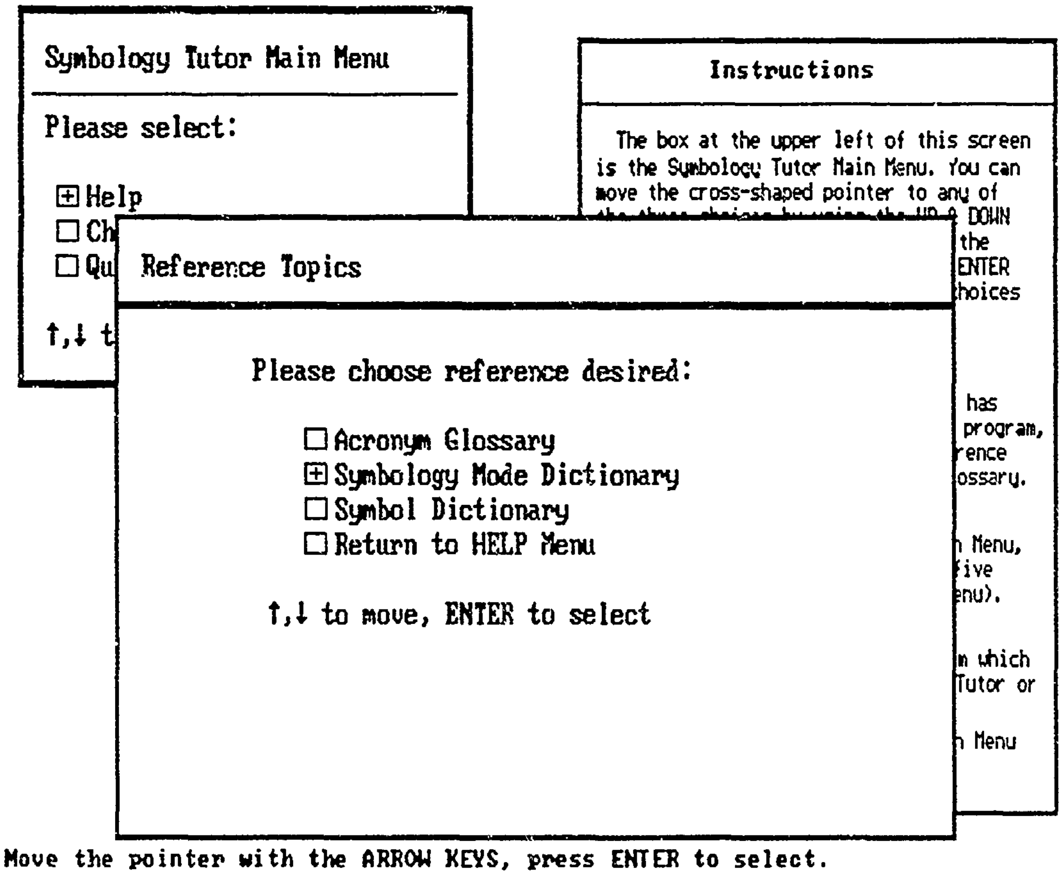


Figure 12. Screen showing options in the reference subsection of the help system.

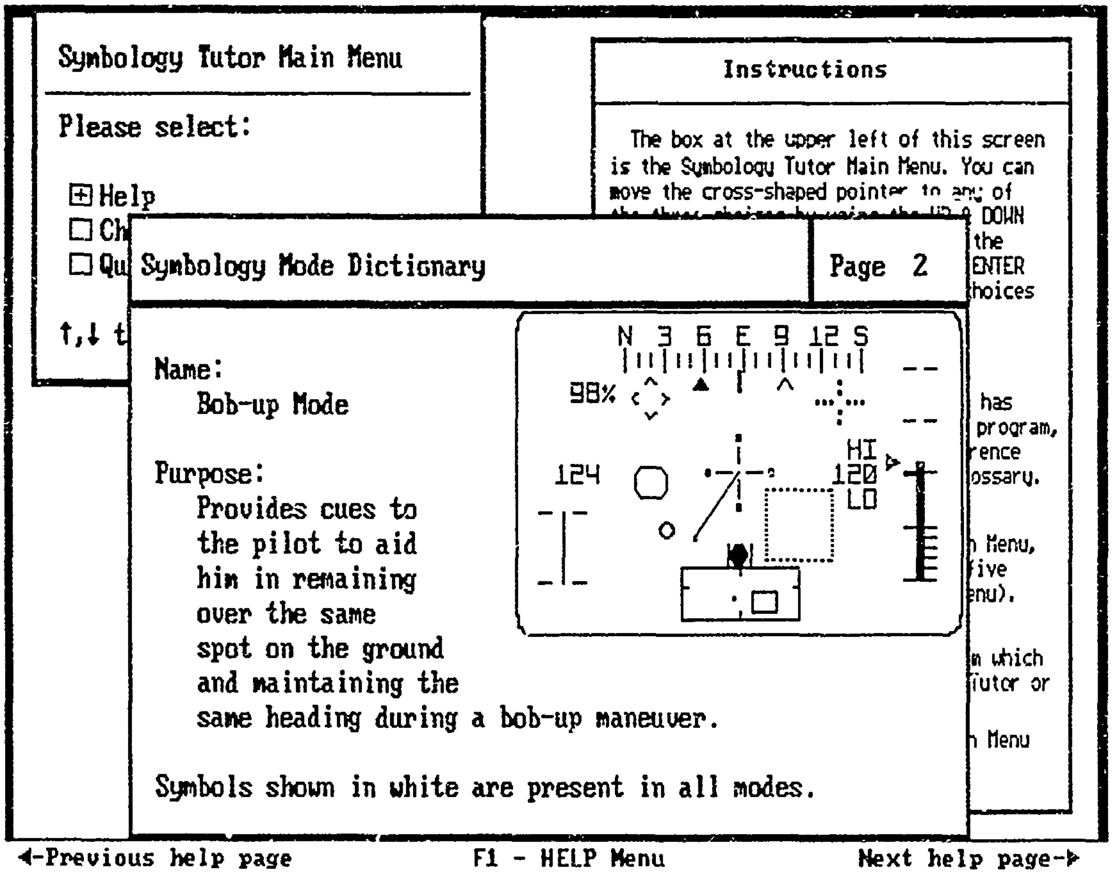


Figure 13. Example of a screen from the symbology mode dictionary.

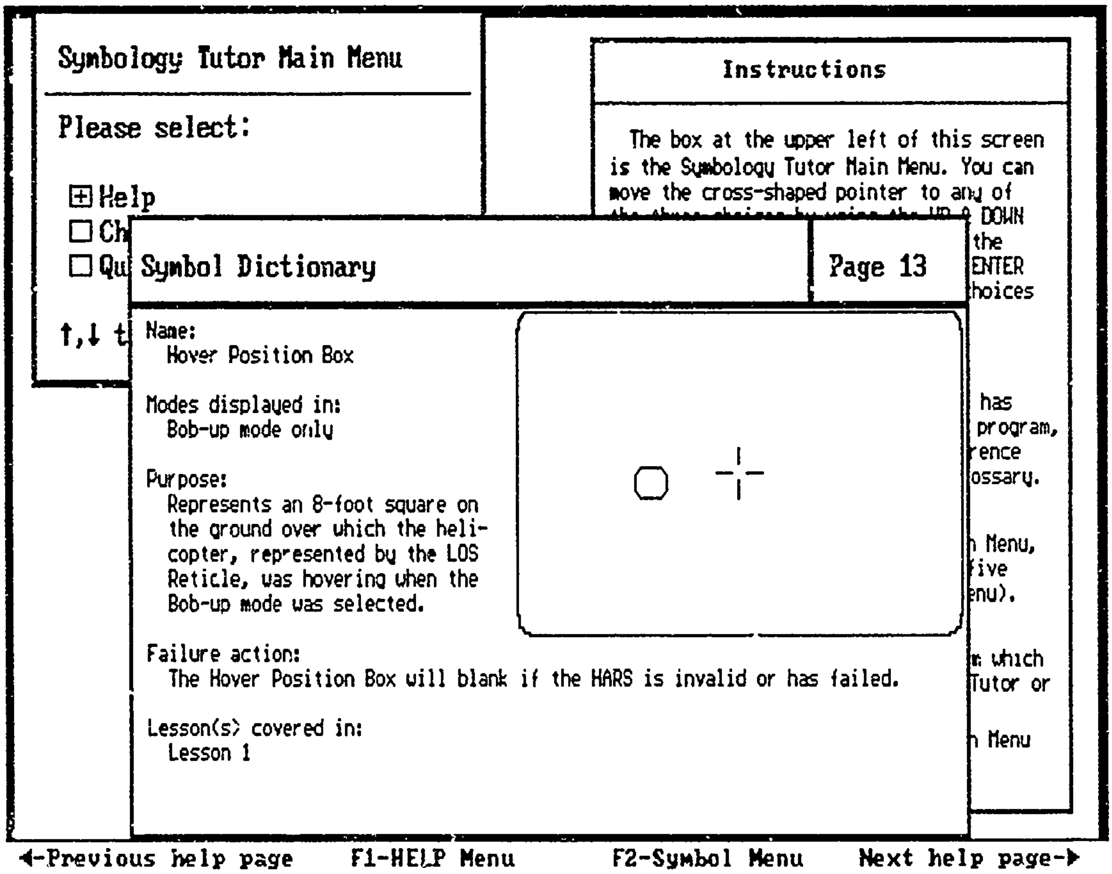


Figure 14. Example of a screen from the symbol dictionary.

Tutorial Section

The tutorial section of the Symbology Tutor provides the student with instructional information about each of the symbols and, when appropriate, illustrates the movement of one or more symbols. To enter the tutorial section for any of the five lessons, the student selects the second option on the main menu. A window then appears on the screen listing the contents of the lessons, as shown in Figure 15. Once the student selects the desired lesson, a screen that gives the student an overview of the lesson is presented. An example of a standard tutorial screen is shown in Figure 16. The storyboard used to produce this screen is shown in Figure 3. An example of a tutorial screen with a supplementary graphic is shown in Figure 17. The storyboard used to produce this screen is shown in Figure 4.

The standard tutorial screen consists of four elements: (a) a lesson status box located in the upper-left corner of the computer screen, (b) a facsimile of an AH-64A display located in the top-center part of the screen, (c) a text box located below the display, and (d) a status line located at the bottom of the screen. The lesson status box shows the number and name of the current lesson and indicates that the student is working in the tutorial section. It also indicates the number of the current frame and the total number of frames in the tutorial. When a supplementary graphic is required, as is the case in Figure 17, the lesson status box is not shown.

The symbol of interest is shown on the display in green, along with other symbols (e.g., the LOS Reticle) that are needed to serve as a reference for that symbol. The reference symbols are normally shown in white, although occasionally a secondary reference symbol or symbols (e.g., the Velocity Vector and the Acceleration Cue) may be shown in yellow to distinguish them from the primary reference symbol.

The majority of the tutorial screens contain static frames to show the shape and location of a symbol. When appropriate, the student is given the option of seeing an animated sequence to illustrate the movement of one or more symbols. For example, the purpose of the tutorial screen may be to show the movement of the Hover Position Box, in conjunction with the Acceleration Cue and the Velocity Vector, when the pilot flies the helicopter to the position in which the bob-up mode was initiated (see Figure 16). A message located at the bottom of the text area prompts the student to begin the animation by pressing the spacebar to simulate a control movement (e.g., moving the helicopter cyclic). The

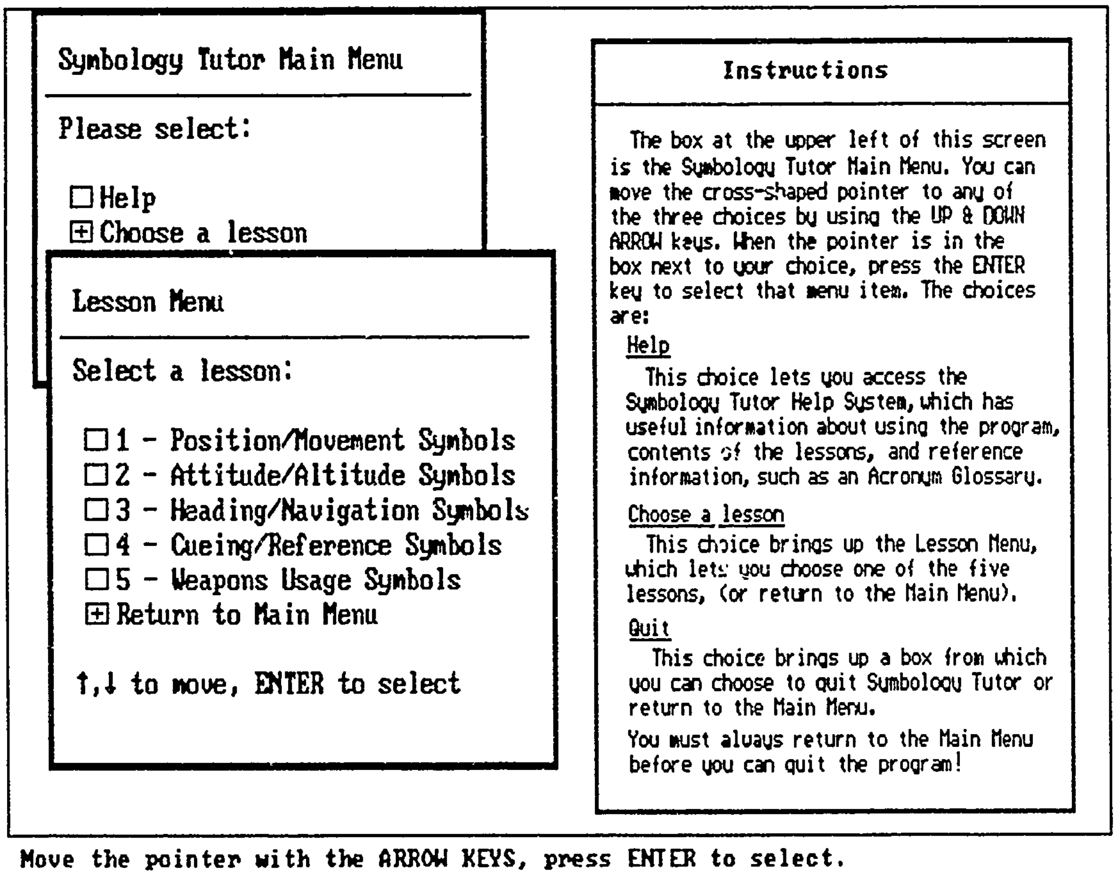


Figure 15. Screen provided to the student for choosing a lesson.

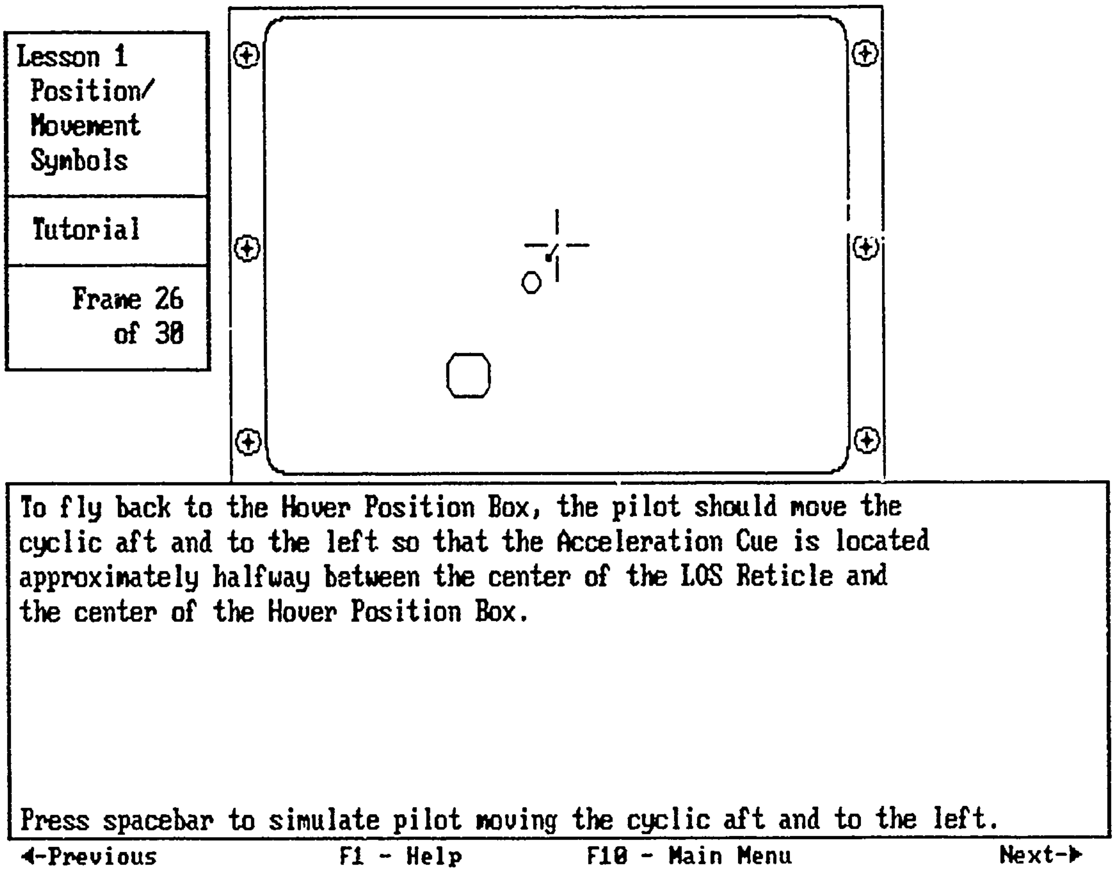


Figure 16. Example of a standard screen from the Lesson 1 tutorial section.

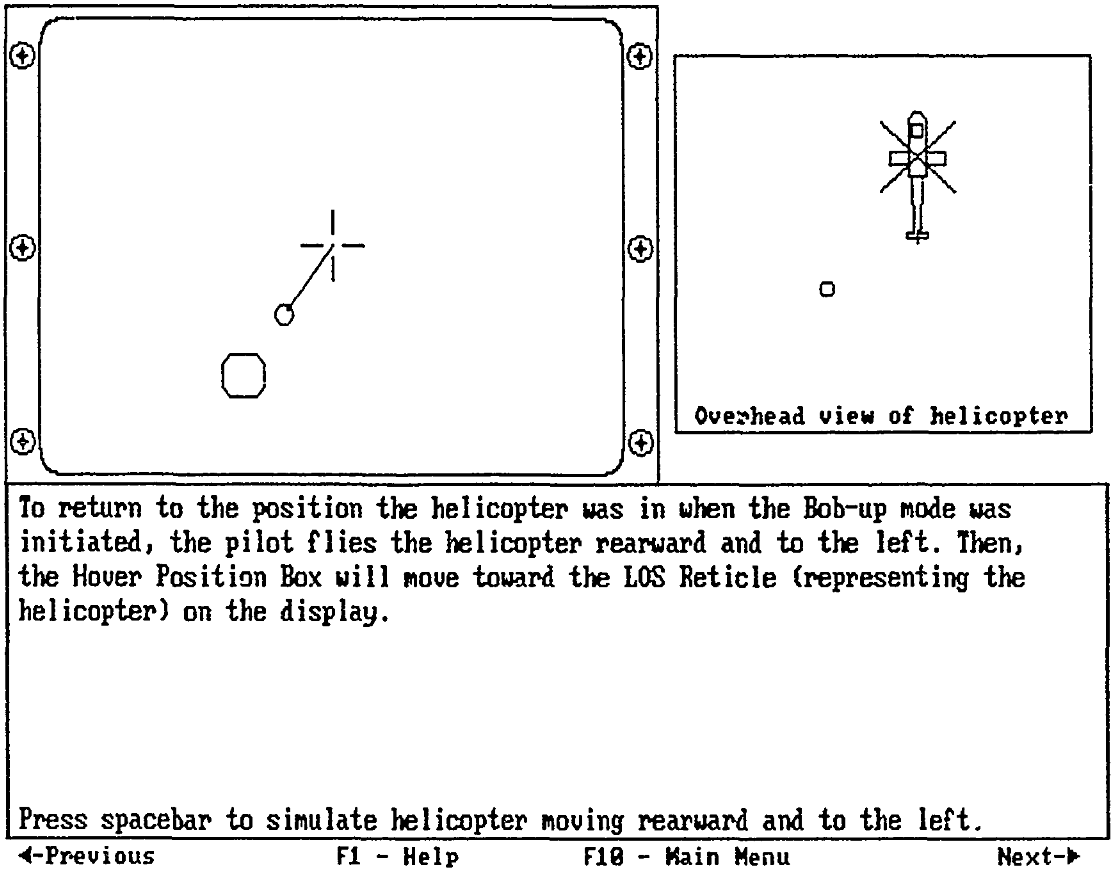


Figure 17. Example of a screen with a supplementary graphic from the Lesson 1 tutorial section.

student can view the animation as many times as desired by pressing the spacebar. Supplementary text is sometimes added to the text box after the animated sequence is completed to provide additional information about the symbology.

Quiz Section

The quiz section assesses the student's understanding of the material presented in the tutorial. After completing a tutorial, the student is given the option of taking the quiz for that lesson or returning to the main menu. An example of a quiz screen is shown in Figure 18. The quiz screen consists of four elements: (a) a lesson status box located in the upper-left corner of the computer screen, (b) a facsimile of the AH-64A display located in the top-center part of the screen, (c) a text box located below the display, and (d) a status line located at the bottom of the screen.

The lesson status box shows the number and name of the current lesson and identifies that the student is working in the quiz section. It also indicates the number of the current frame, the total number of frames in the quiz, and the number of correct and incorrect items at that point in the quiz.

The quiz questions are presented in a multiple choice format with one correct answer and three distractors. When the question appears, a cross-shaped pointer is displayed between the item stem and the four possible answers. The student chooses the answer by using the arrow keys to move the pointer to the box at the left of the answer and pressing the ENTER key (see Figure 18). After the student chooses an answer, the program indicates at the bottom-left part of the screen whether the response is correct or incorrect. If the student chooses an incorrect answer, the program branches to the tutorial frames that contain remedial information for that question. Following the remediation material, the program returns to the next quiz question.

After the student has answered the last quiz question, the program indicates the total number of correct and incorrect responses. If the student answered any question incorrectly, the program branches to the questions that the student missed and continues to cycle through the incorrectly answered questions until all questions are answered correctly. After answering all the quiz questions correctly, the student is given the option of viewing the lesson tutorial again or returning to the main menu.

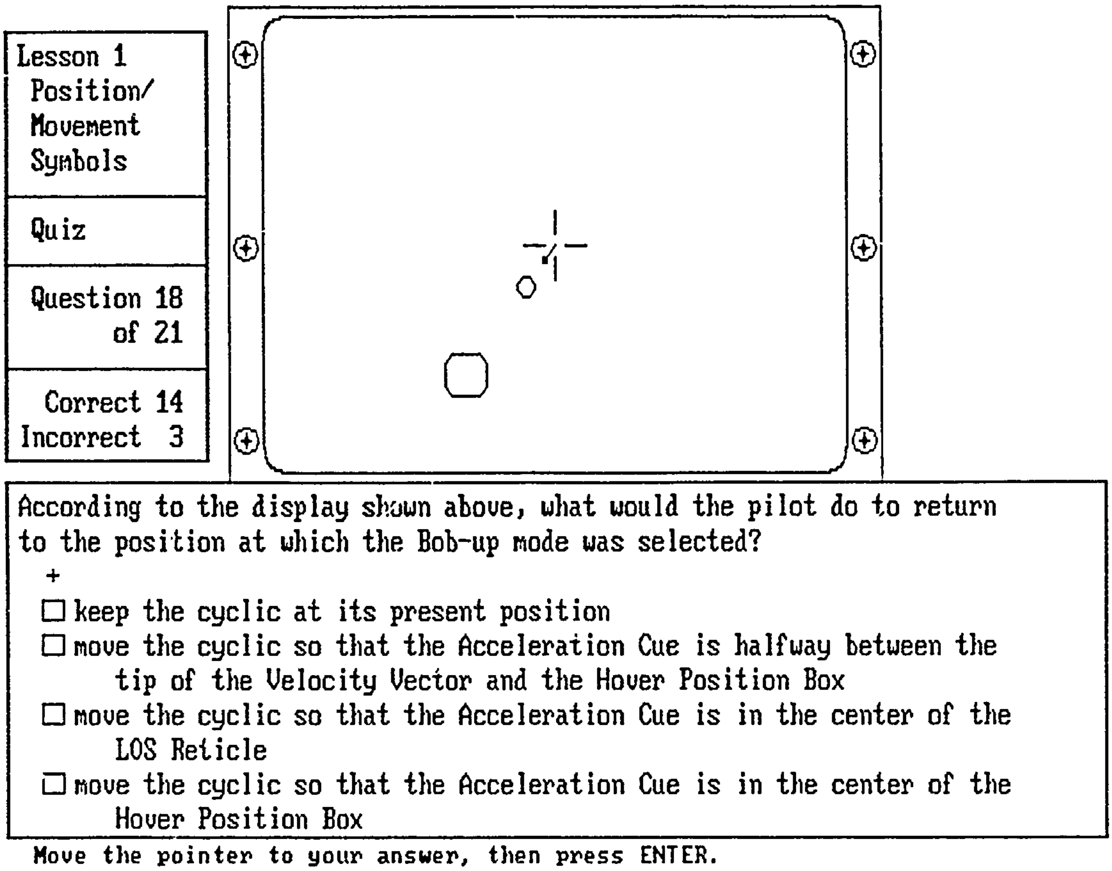


Figure 18. Example of a screen from the Lesson 1 quiz section.

Hardware Requirements

The training module is written in Microsoft QuickBASIC and is designed to run on a Zenith PC AT-compatible micro-computer equipped with one megabyte of random access memory, a hard disk with at least two megabytes available, an enhanced graphics adapter (EGA), and a high resolution EGA color monitor. The program can be run using a monochrome monitor, but will require that the screen brightness and contrast be adjusted to ensure proper visibility.

APPENDIX A

SYMBOLOGY TUTOR STORYBOARDS FOR LESSON 1: POSITION/MOVEMENT SYMBOLS

Lesson 1

Position/Movement Symbols

The purpose of this lesson is to teach you to identify and understand the meaning of symbols in the Flight Symbology set that give the pilot information about the position and movement of the helicopter over the ground.

The specific symbols covered in this lesson are:

- The Line of Sight (LOS) Reticle
- The Airspeed Digital Readout
- The Velocity Vector
- The Acceleration Cue
- The Hover Position Box

The word "green" is shown in the color green; the word "blue" is shown in the color blue.

This lesson is divided into two parts: A Tutorial and a Quiz.

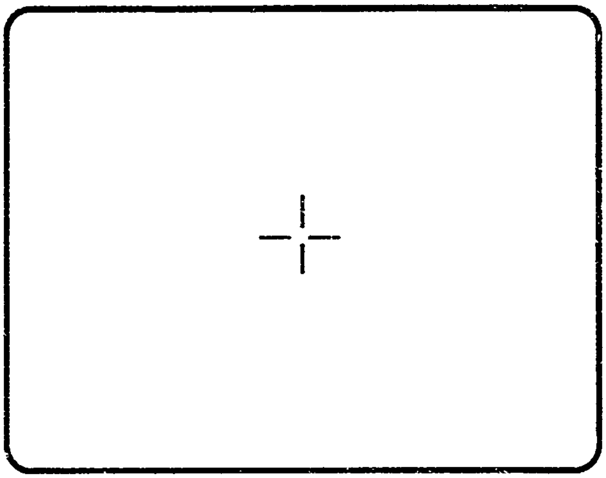
Tutorial

In the first part, a facsimile of an AH-64 visual display showing one symbol or a small group of symbols is shown on the top part of the screen. The symbol or symbols of interest are highlighted in **green** and described briefly below the display. Supplementary material that does not appear on the AH-64 display is shown in **blue**. In some cases, you will have the opportunity to see a brief demonstration of how the symbol or symbols move in the display.

Quiz

The second part of this lesson consists of a quiz covering the material you have just learned. If you answer a question incorrectly, you will briefly review the material covered in that question before proceeding with the quiz. After you have completed the quiz, you will have the opportunity to review the lesson again, go on to another lesson, or quit the program.

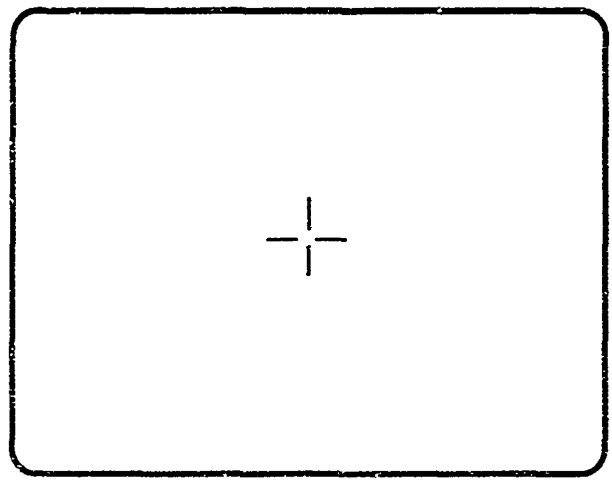
The LOS Reticle is highlighted in green.



This is the **LOS Reticle.**

It shows the pilot's Integrated Helmet and Display Sighting System (IHADSS) line of sight (LOS). It also serves as a reference for some of the other symbols.

The LOS Reticle is highlighted in green.



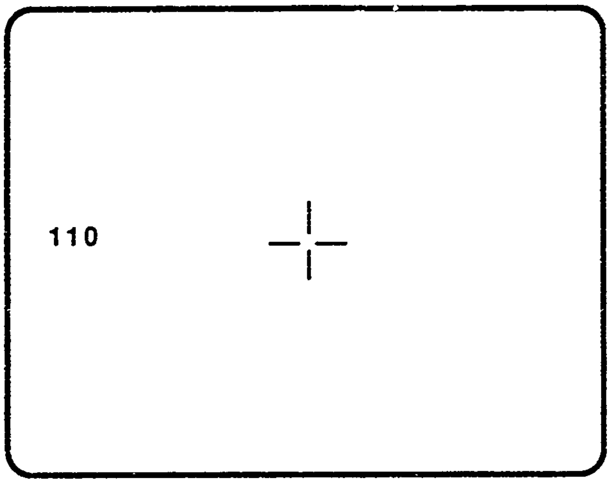
The LOS Reticle will flash when the pilot's LOS is invalid or has failed.

Press spacebar to simulate invalid LOS.

The LOS Reticle flashes at rate of .75 sec on/.25 sec off.

Press spacebar to see demonstration again.

The Airspeed Digital Readout is highlighted in green.



This is the **Airspeed Digital Readout.**

It normally shows the airspeed of the helicopter, from 0 to 200 knots in 1 knot increments.

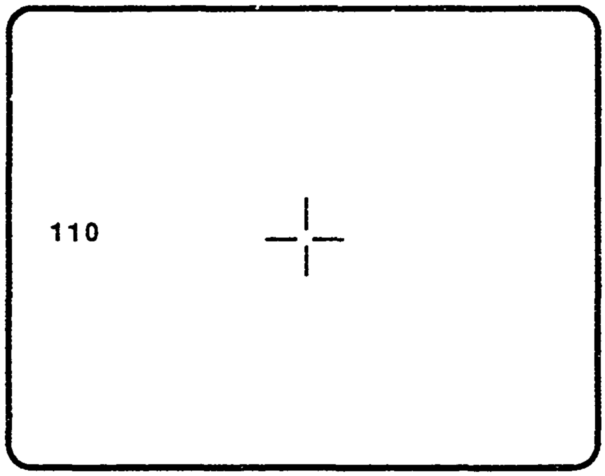
It represents the helicopter's true airspeed in any direction, if the Air Data Sensor Subsystem (ADSS) is valid.

Press spacebar for demonstration.

The Airspeed Digital Readout increases from 110 knots to 120 knots in 1 knot increments.

Press spacebar to see demonstration again.

The Airspeed Digital Readout is highlighted in green.



The Airspeed Digital Readout will indicate ground speed in knots when:

- the Air Data Sensor Subsystem (ADSS) is OFF or has failed, and
- the doppler ground speed is valid.

When these two conditions are true, the Airspeed Digital Readout will initially decrease to zero. It will then increase to doppler ground speed.

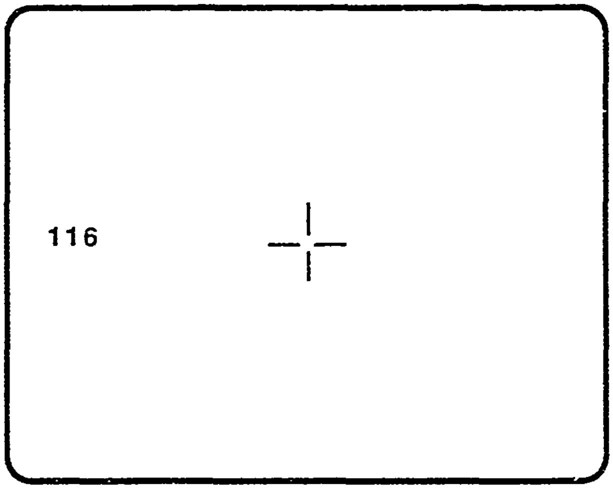
In this case the doppler ground speed is 100 knots.

Press spacebar to simulate ADSS failure with valid doppler ground speed.

The Airspeed Digital Readout decreases to 0 knots, and then increases to 100 knots in 1 knot increments.

Press spacebar to see demonstration again.

The Airspeed Digital Readout is highlighted in green.



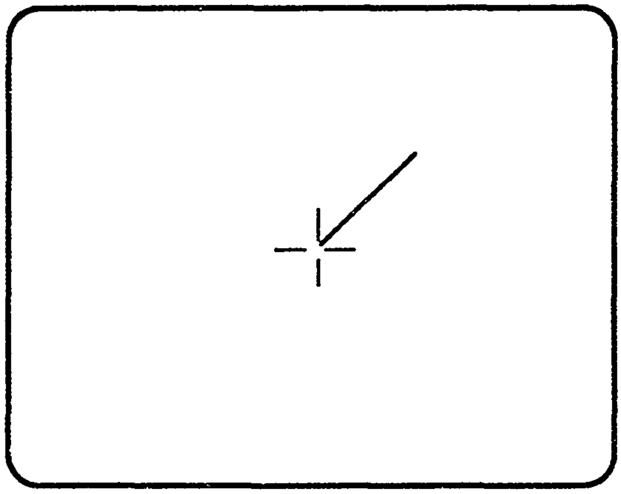
The Airspeed Digital Readout will blank when:
- the ADSS airspeed output is invalid, and
- the doppler ground speed output is invalid.

Press spacebar to simulate invalid ADSS airspeed and doppler ground speed.

After 2 seconds, the Airspeed Digital Readout blanks.

Press spacebar to see demonstration again.

The Velocity Vector is highlighted in green.



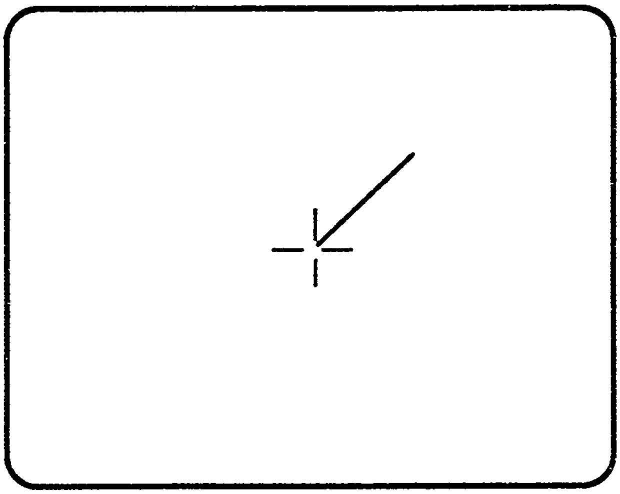
This is the **Velocity Vector**.

It indicates the direction and magnitude of the helicopter's movement over the ground in reference to the center of the LOS Reticle (the point of origin for the Velocity Vector).

The Velocity Vector is shown in the hover, bob-up, and transition modes of symbology.

It is not shown in the cruise mode.

The Velocity Vector is highlighted in green.

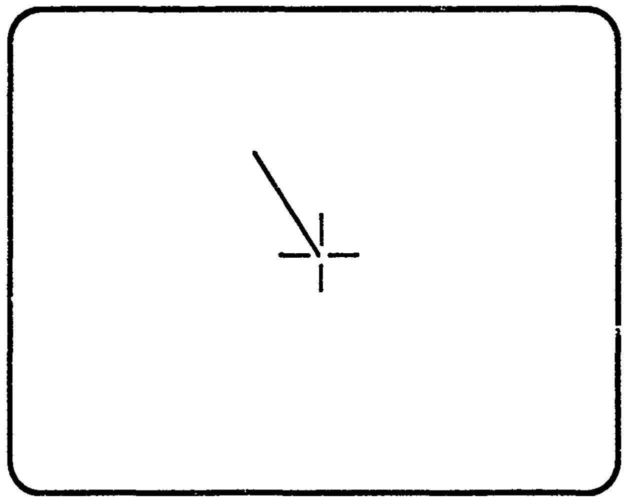


The length of the Velocity Vector is the distance between the center of the LOS Reticle and the tip of the Velocity Vector.

The scale used to interpret the length of the Velocity Vector depends on the mode of symbology.

In the hover or bob-up modes, the distance between the center of the LOS Reticle and the edges of the display (the maximum length of the Velocity Vector) represents only 6 knots.

The Velocity Vector is highlighted in green.

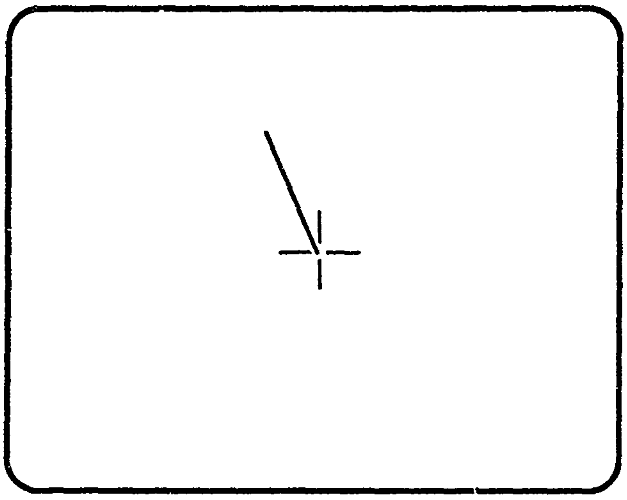


For example, in the display shown above, the pilot has selected the hover mode.

The Velocity Vector indicates that the helicopter is moving forward and to the left at a ground speed of approximately 3 knots because:

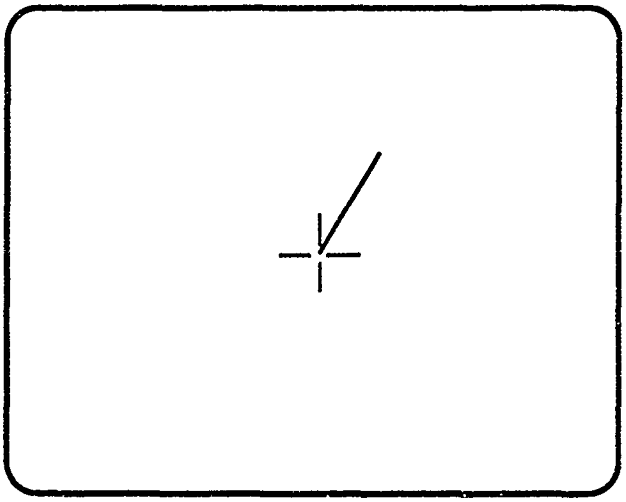
- the pilot has selected the hover mode,
- the distance between the center of the LOS Reticle and the edges of the display represents 6 knots in hover mode, and
- the Velocity Vector is approximately half its maximum length.

The Velocity Vector is highlighted in green.



In the transition mode, the difference between the center of the LOS Reticle and the edges of the display represents 60 knots.

The Velocity Vector is highlighted in green.

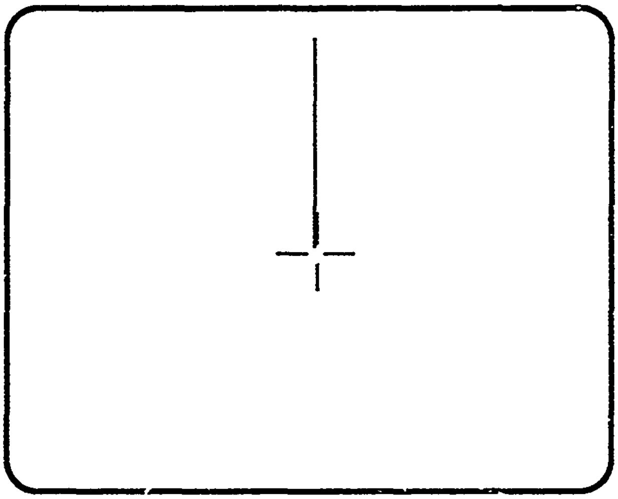


For example, in the display shown above the pilot has selected the <u>transition</u> mode.

The Velocity Vector indicates that the helicopter is moving forward and to the right at a ground speed of approximately 30 knots, because:

- the pilot has selected the transition mode,
- the distance between the center of the LOS Reticle and the edges of the display represents 60 knots in the transition mode, and
- the Velocity Vector is approximately half its maximum length.

The Velocity Vector is highlighted in green.



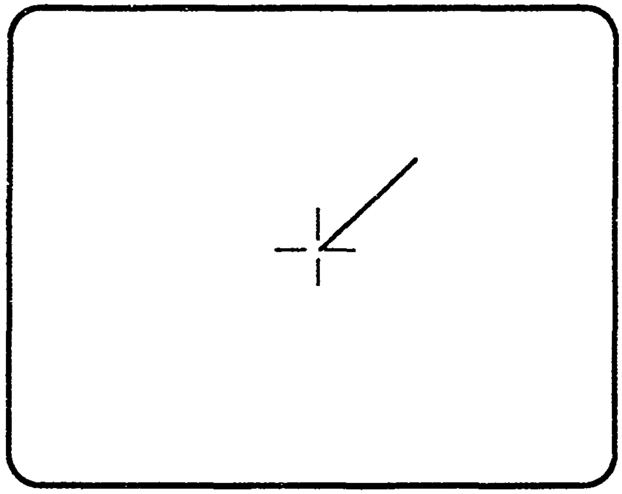
When in the hover or bob-up modes, the Velocity Vector will saturate, or reach its maximum length, at 6 knots ground speed. When in the transition mode, the Velocity Vector will saturate at 60 knots ground speed.

Once the Velocity Vector saturates, it will remain at its maximum length but will continue to indicate changes in velocity angles.

Press spacebar for demonstration.

Velocity Vector retains same length and moves from present position to a position 45 degrees to the right in approximately 1 second.

The Velocity Vector is highlighted in green.



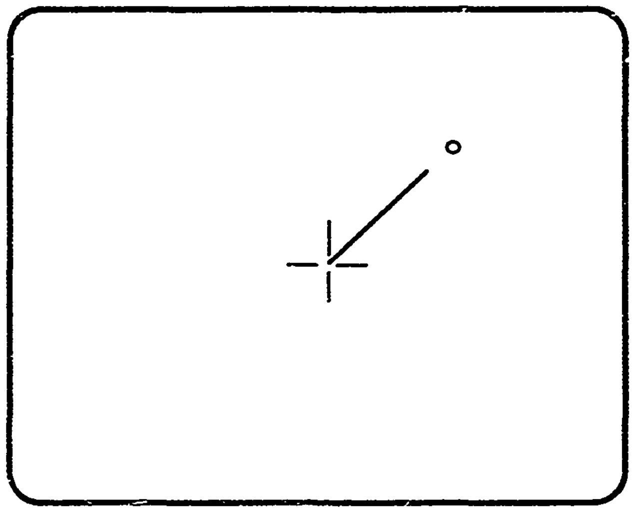
The Velocity Vector will flash when the Heading and Attitude Reference System (HARS) inertial platform has gone into free inertial mode, usually as a result of the doppler navigation system being in memory or having failed.

Press spacebar to simulate HARS failure.

The Velocity Vector flashes at a rate of .75 sec on/.25 sec off.

Press spacebar to see demonstration again.

The Acceleration Cue is highlighted in green.



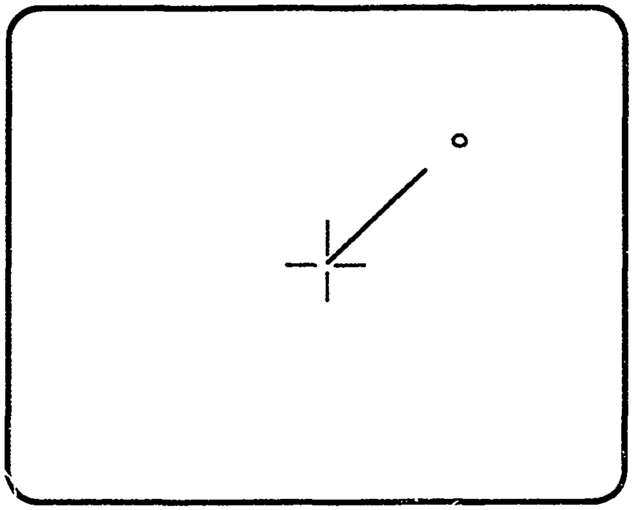
This is the **Acceleration Cue**.

It indicates the direction and amount that the helicopter will be accelerating, normally in reference to the tip of the Velocity Vector.

It is shown in the hover, bob-up, and transition modes of symbology.

It is not displayed in the cruise mode.

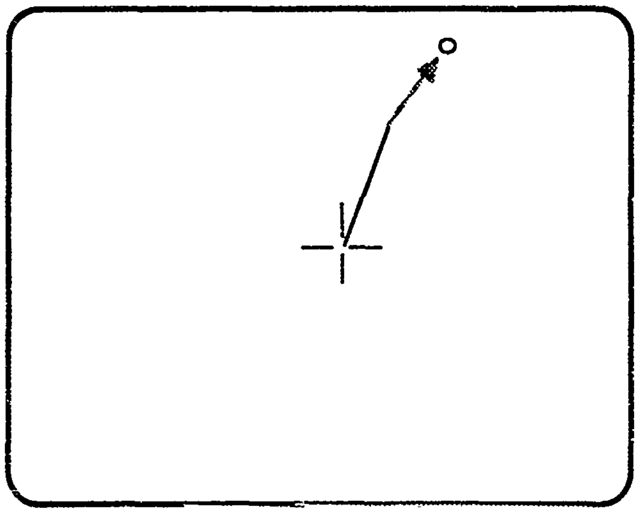
The Acceleration Cue is highlighted in green.



The Acceleration Cue serves as a helicopter "motion anticipator," or an indication of the desired amount and direction of acceleration.

It may be helpful to think of the Acceleration Cue as representing the top of the cyclic.

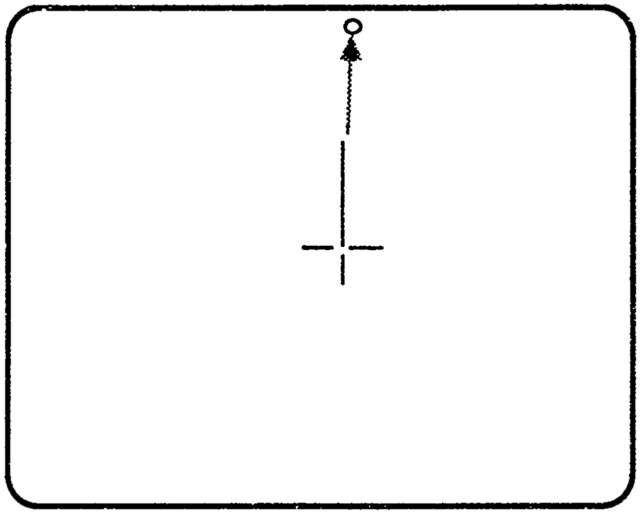
The Acceleration Cue is highlighted in green; the dotted arrow is shown in blue.



The Acceleration Cue is the endpoint of an invisible acceleration vector whose point of origin is usually the tip of the Velocity Vector. The acceleration vector is represented by the blue arrow in this display.

As shown in this display, the helicopter will be accelerating forward and to the right of its present course, because the Acceleration Cue is above and to the right of the tip of the Velocity Vector.

The Acceleration Cue is highlighted in green. The dotted arrow is shown in blue.



As the helicopter accelerates, the Velocity Vector will extend until it reaches the Acceleration Cue.

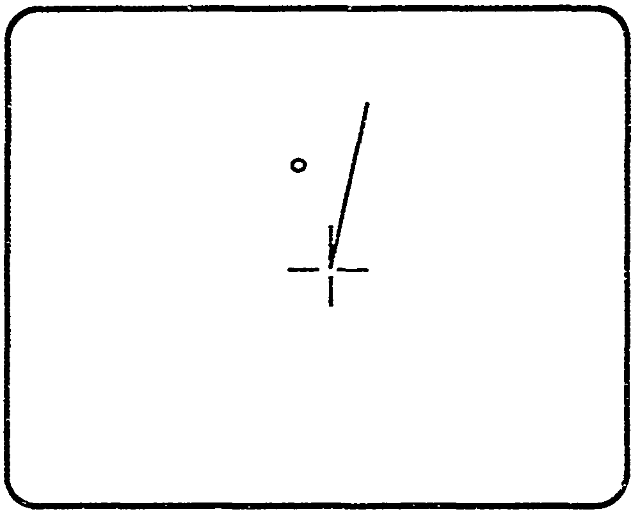
Press spacebar for demonstration.

Velocity Vector extends until it reaches the Acceleration Cue, then stops. Blue arrow decreases in size. Then display the following text:

When the Velocity Vector has reached the Acceleration Cue, the helicopter has stopped accelerating and is traveling at a constant velocity.

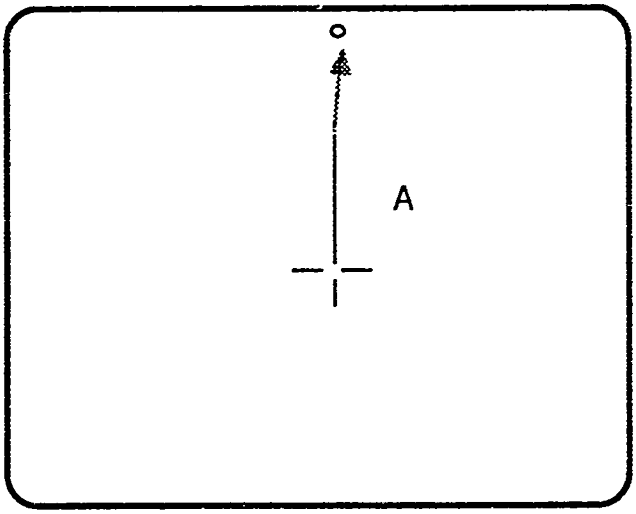
Press spacebar to see demonstration again.

The Acceleration Cue is highlighted in green.



As shown in this display, the helicopter will be decelerating and moving to the left.

The Acceleration Cue is highlighted in green. Dotted arrow is shown in blue. Letter is not shown.



In hover or bob-up modes, when the Velocity Vector reaches its maximum length (at 6 knots ground speed or greater), the point of origin for the Acceleration Cue changes from the tip of the Velocity Vector to the center of the LOS Reticle.

Press spacebar for demonstration.

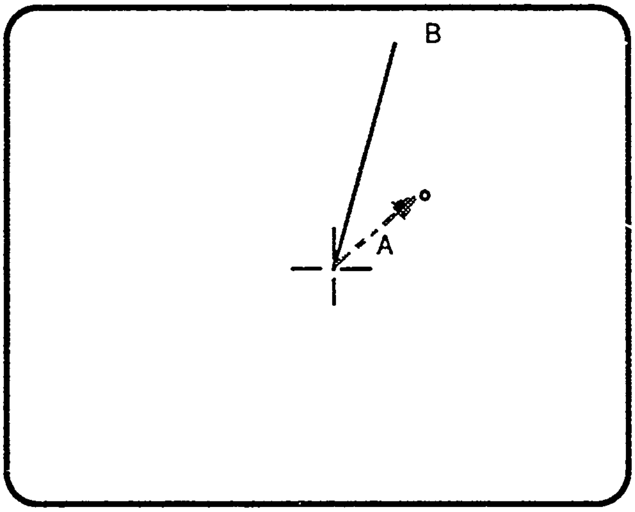
Velocity Vector grows to meet Acceleration Cue, blue arrow decreases in size. Then Acceleration Cue disappears and reappears at position "A", blue arrow is drawn from the center of the LOS Reticle to the Acceleration Cue at position "A". Then add the following:

The point of origin for the Acceleration Cue is now the center of the LOS Reticle because:

- the Velocity Vector is at its maximum length, and
- the pilot has selected either the hover or the bob-up mode.

Press spacebar to see demonstration again.

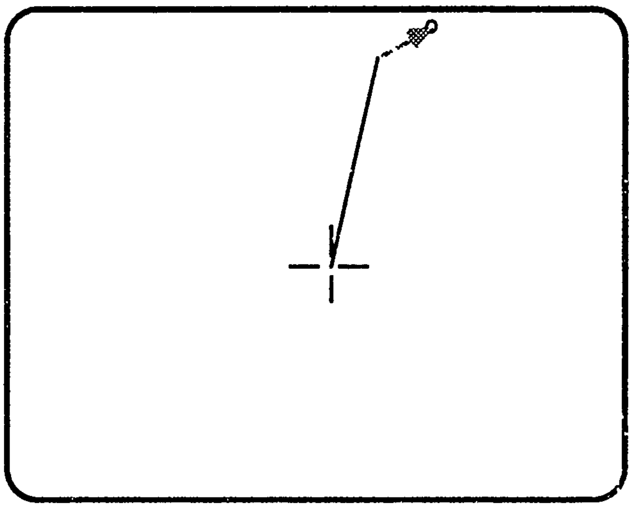
The Acceleration Cue is highlighted in green. Dotted arrow is shown in blue. Letter is not shown.



In the hover or bob-up modes, when the ground speed of the helicopter decreases below 6 knots, the point of origin for the Acceleration Cue is <u>again</u> the tip of the Velocity Vector.

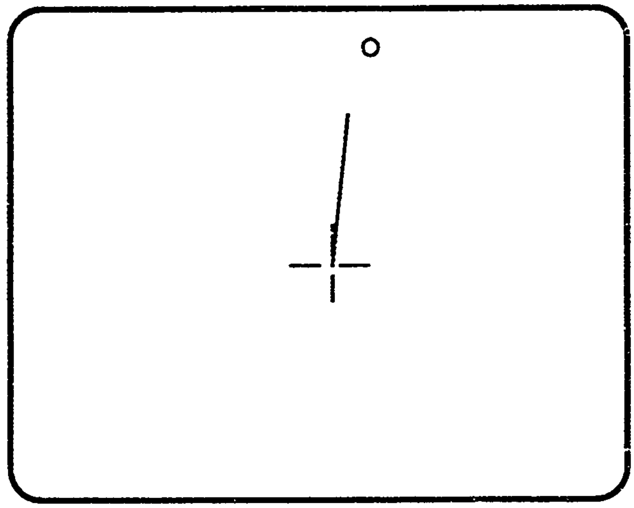
Press spacebar for demonstration.

The Acceleration Cue moves to position "A". The Velocity Vector decreases slightly. The Acceleration Cue then disappears and reappears at position "B". A blue arrow is drawn from the tip of the Velocity Vector to the Acceleration Cue. The sequence takes approximately three seconds. Then display looks like this:



Press spacebar to see demonstration again.

The Acceleration Cue is highlighted in green.



In the transition mode, the point of origin for the Acceleration Cue is always the tip of the Velocity Vector.

This is true regardless of the length of the Velocity Vector (which represents the ground speed of the helicopter).

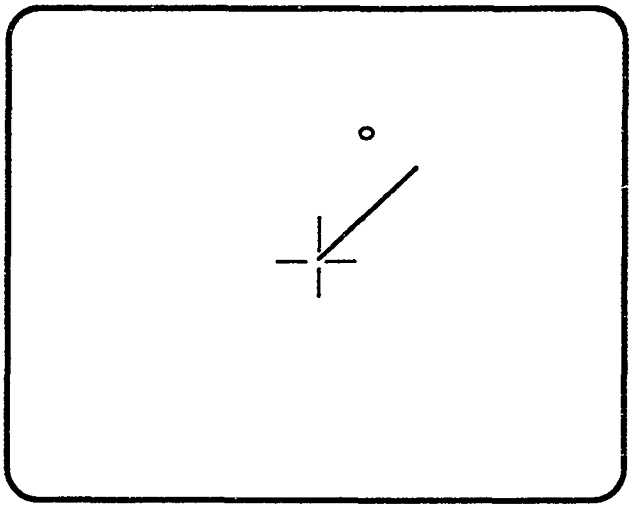
Press spacebar for demonstration.

Velocity Vector extends to Acceleration Cue. Acceleration Cue then moves approximately one inch to the left, stops, and moves back to original position. Velocity Vector lags behind the Acceleration Cue. The sequence takes approximately 2 seconds. Then add the following text:

Even though the Velocity Vector is now at its maximum length, the point of origin for the Acceleration Cue is still the tip of the Velocity Vector because the pilot has selected the transition mode.

Press spacebar to see demonstration again.

The Acceleration Cue is highlighted in green.



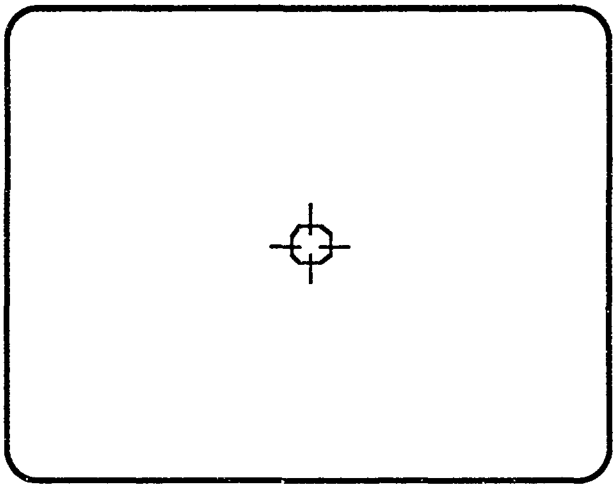
The Acceleration Cue (along with the Velocity Vector) flashes when the HARS is in free inertial or the doppler is in memory or has failed.

Press spacebar to simulate HARS or doppler failure.

The Velocity Vector flashes at a rate of .75 sec on/.25 sec off.

Press spacebar to see demonstration again.

The Hover Position Box is highlighted in green.

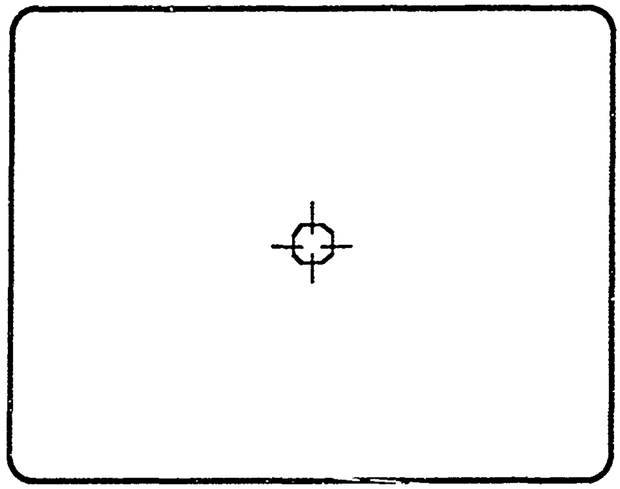


This is the **Hover Position Box.**

It represents an 8-foot square on the ground over which the helicopter, represented by the pilot's LOS Reticle, was hovering when the bob-up mode was selected.

The Hover Position Box is shown only in the bob-up mode of symbology.

The Hover Position Box is highlighted in green.



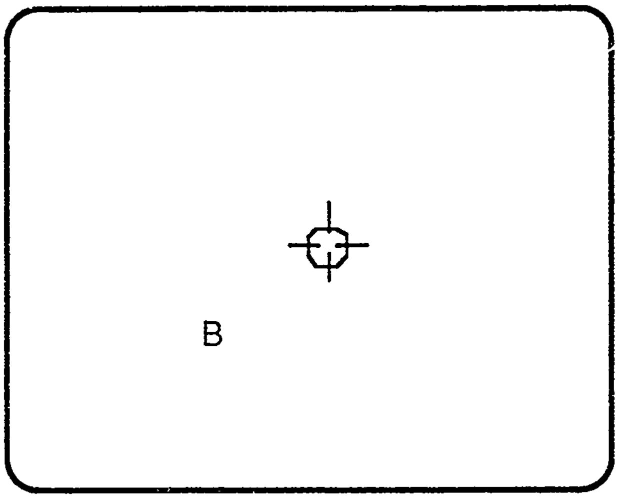
When the bob-up mode is initiated, the Hover Position Box is displayed centered around the middle of the LOS.

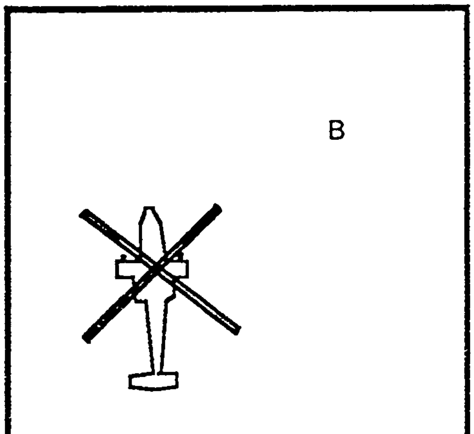
Press spacebar to simulate initiation of bob-up mode.

The Hover Position Box appears centered on the LOS Reticle.

Press spacebar to see demonstration again.

The Hover Position Box is highlighted in green. Overhead view of the helicopter is shown to the right of the display. Letters are not shown.





Overhead view of helicopter

The Hover Position Box moves away from the stationary LOS Reticle on the display in the opposite direction that the helicopter is moving.

In this case the helicopter is moving forward and to the right.

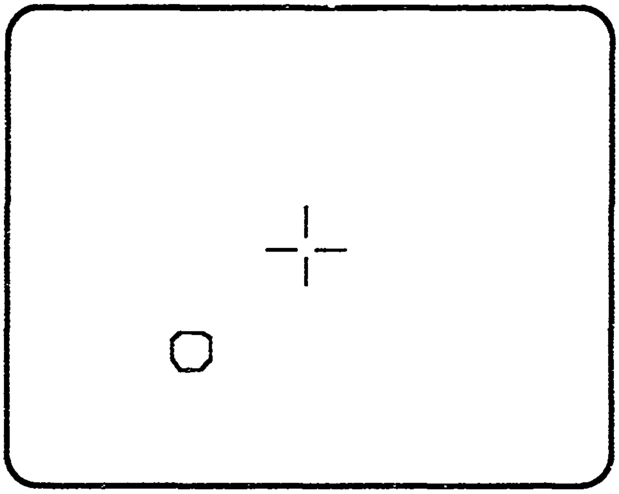
Press spacebar for demonstration.

The Hover Position Box moves to position "A". Helicopter starts at present position and moves diagonally to position "B", always facing forward. Small circle remains in helicopter's old position. Then add the following text:

As shown in this display, the Hover Position Box moved downward and to the left, indicating that the helicopter moved forward and to the right.

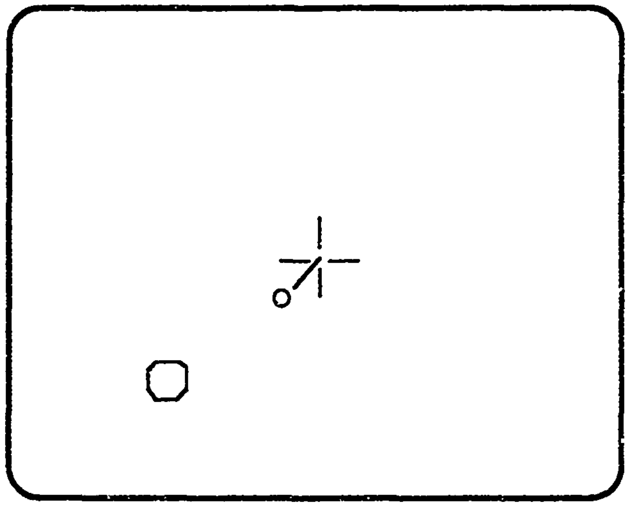
Press spacebar to see demonstration again.

The Hover Position Box is highlighted in green.



The location of the Hover Position Box in this display indicates that the pilot needs to fly to the left and to the rear to be over the ground position at which the bob-up mode was selected.

The Hover Position Box is highlighted in green; Acceleration Cue and Velocity Vector are shown in yellow.



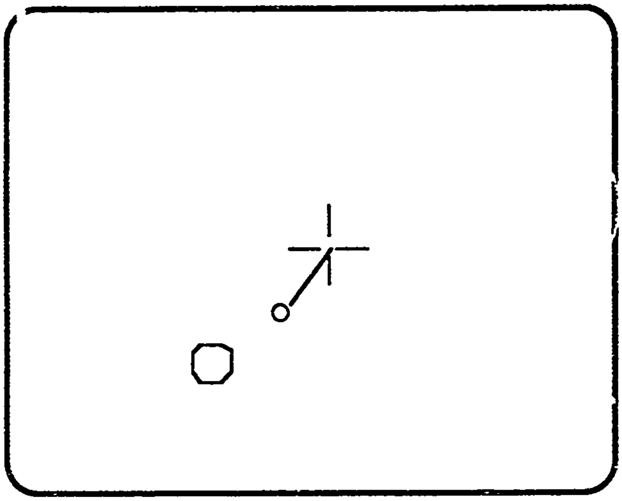
To fly back to the Hover Position Box, the pilot should move the cyclic aft and to the left so that the Acceleration Cue is located approximately halfway between the center of the LOS Reticle and the center of the Hover Position Box.

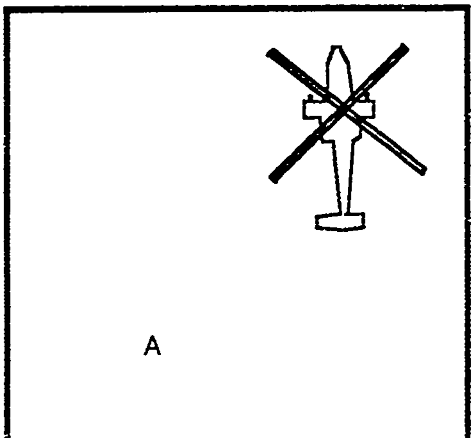
Press spacebar to simulate pilot moving cyclic aft and to the left.

Acceleration Cue, shown in yellow, moves to a position halfway between the LOS Reticle and the Hover Position Box. Velocity Vector extends to meet the Acceleration Cue.

Press spacebar to see demonstration again.

The Hover Position Box is highlighted in green; Acceleration Cue and Velocity Vector are shown in yellow. Letter is not shown.





Overhead view of helicopter

To return to the position the helicopter was in when the bob-up mode was initiated, the pilot flies the helicopter rearward and to the left. Then the Hover Position Box moves toward the LOS Reticle (representing the helicopter) on the display.

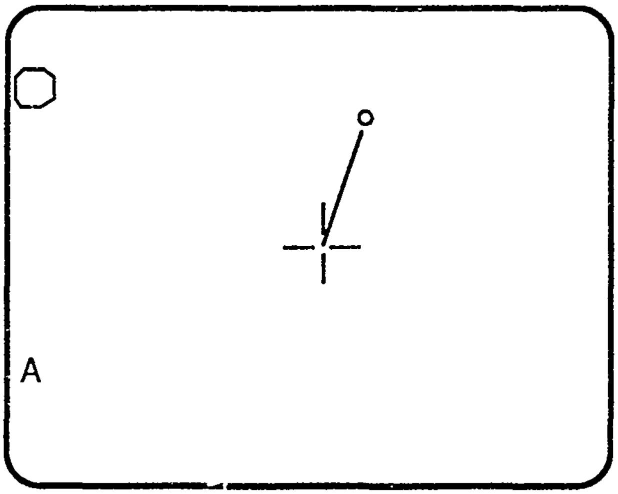
Press spacebar for demonstration.

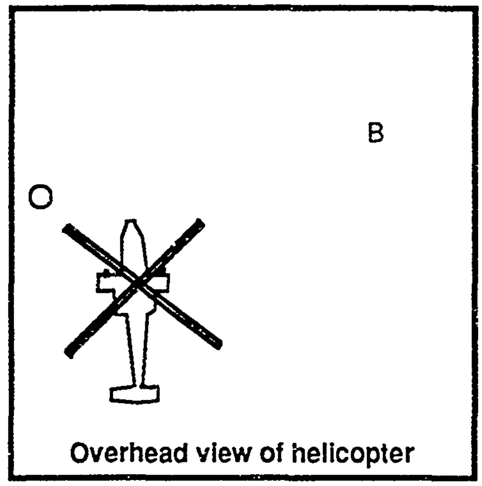
Hover Position Box moves upward and to the right until it is centered on the LOS Reticle. Acceleration Cue precedes Hover Position Box. Velocity Vector shortens and eventually disappears. Helicopter moves from present position to position "A". Acceleration Cue is then centered in the LOS Reticle. Then add the following text:

Once the pilot has returned to the position at which the bob-up mode was initiated, the Hover Position Box again will be centered on the LOS Reticle.

Press spacebar to see demonstration again.

*The Hover Position Box is highlighted in green.
Letters are not shown.*





The maximum displacement of the Hover Position Box is 44 feet laterally or longitudinally.

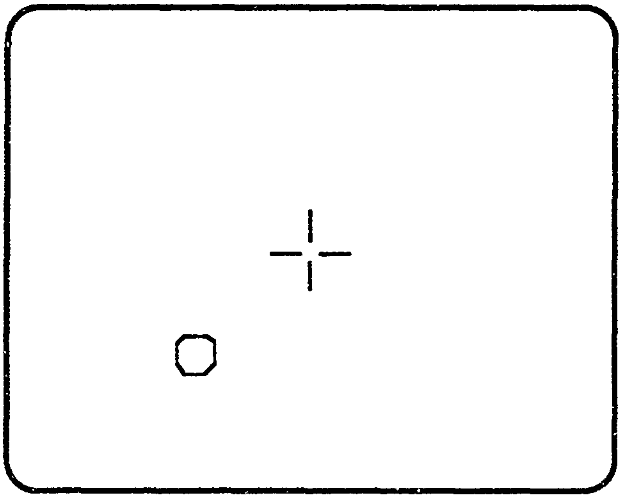
When the helicopter exceeds the lateral or longitudinal limits, the Hover Position Box will remain at the edge of the display and continue to indicate the direction the pilot needs to fly to return to the position at which the bob-up mode was selected.

Press spacebar to simulate helicopter exceeding the lateral limits.

Hover Position Box moves to position "A" while helicopter moves diagonally from present position to position "B", always facing forward.

Press spacebar to see demonstration again.

The Hover Position Box is highlighted in green.



The Hover Position Box blanks when the HARS is invalid.

Press spacebar to simulate HARS failure.

After 3 seconds, Hover Position Box disappears from the display.

Press spacebar to see demonstration again.

You have now completed the lesson on Position/Movement Symbols.

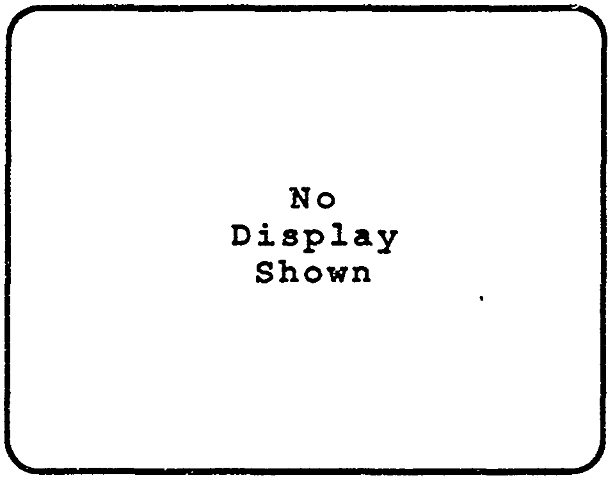
Please select what you would like to do now:

- Take the Quiz
- Return to the Main Menu

Symbology Tutor Quiz - Lesson 1: Position/Movement Symbols

This quiz tests how much you learned about the Position/Movement Symbols presented in Lesson 1. The quiz consists of 21 multiple choice questions. Each answer has a small box associated with it. You will see a cross-shaped pointer just below the question and above the answer boxes. Use the arrow keys on the numeric keypad to move the pointer to the box next to your answer, then press ENTER to confirm your answer. You must answer each question correctly one time before you may leave the quiz.

Press ENTER to begin the quiz.



If the pilot's LOS is invalid or has failed, the LOS Reticle will:
1) flash
2) blank
3) remain in the center of the display
4) be surrounded by four flashing dots

Correct answer = 1. If response = 2, 3, or 4, go to I-T2.

**No
Display
Shown**

The Airspeed Digital Readout normally shows the airspeed of the helicopter:

1) between 0 and 150 knots in 1 knot increments
2) between 0 and 200 knots in 1 knot increments
3) between 0 and 150 knots in 5 knot increments
4) between 0 and 200 knots in 5 knot increments

Correct answer = 2. If response = 1, 3, or 4, go to I-T3.

**No
Display
Shown**

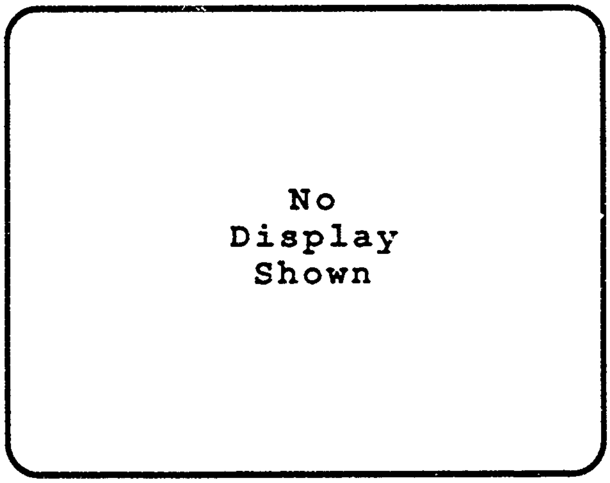
The Airspeed Digital Readout will show the ground speed of the helicopter when:
1) the HARS has failed
2) the Lightweight Doppler Navigation System (LDNS) has failed
3) the ADSS has failed
4) the pilot initiates the hover mode

Correct answer = 3. If response = 1, 2, or 4, go to I-T4.

No
Display
Shown

If both the ADSS airspeed and the doppler ground speed outputs are invalid, the Airspeed Digital Readout will:
1) flash
2) blank
3) show the helicopter's ground speed
4) be surrounded by a flashing rectangular box

Correct answer = 2. If response = 1, 3, or 4, go to I-T5.



The Velocity Vector indicates:

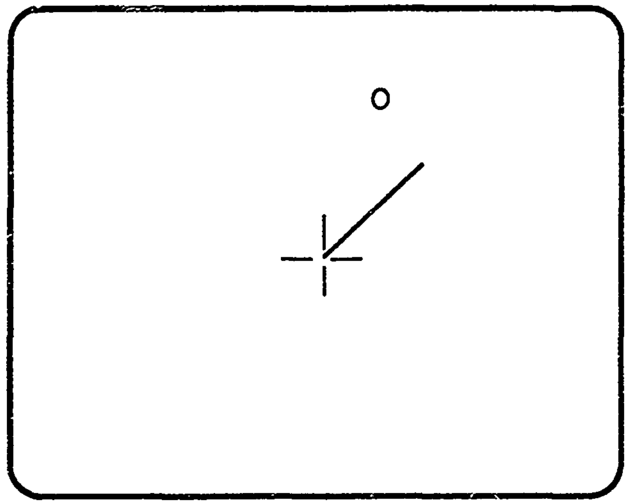
1) only the direction of the helicopter's movement over the ground
2) only the magnitude of the helicopter's movement over the ground
3) both the direction and magnitude of the helicopter's movement over the ground
4) both the direction and magnitude of the helicopter's movement through the air

Correct answer = 3. If response = 1, 2, or 4, go to I-T6.

No
Display
Shown

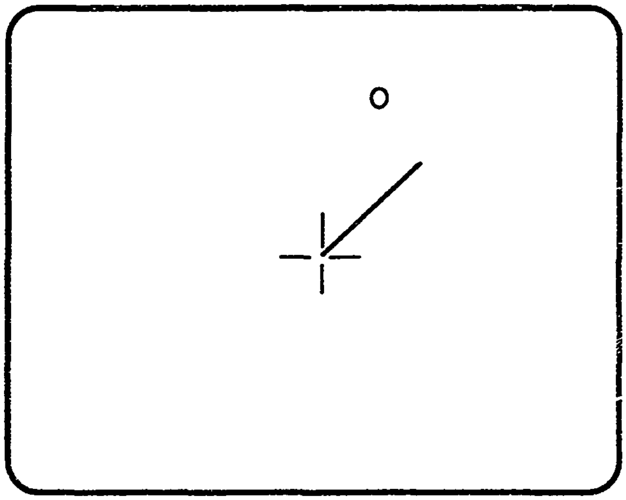
In which modes of symbology will the Velocity Vector be shown?
1) the hover and bob-up modes
2) the transition and cruise modes
3) the hover, bob-up, and cruise modes
4) the hover, bob-up, and transition modes

Correct answer = 4. If response = 1, 2, or 3, go to I-T6.



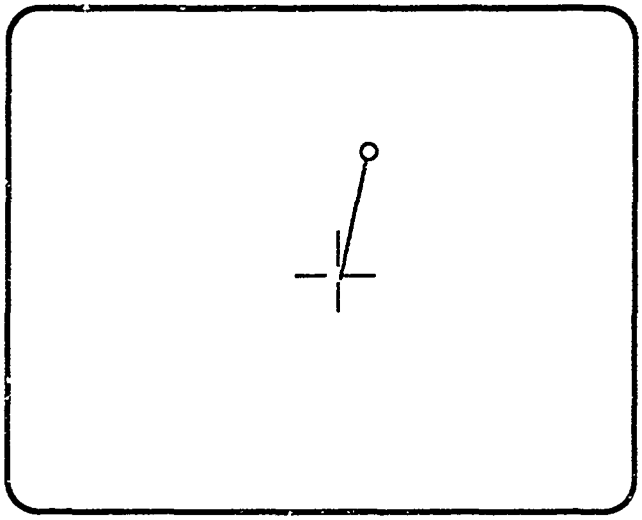
As shown in this display, if the pilot has selected the transition mode, the origin for the Acceleration Cue is:
1) the center of the LOS Reticle
2) the bottom of the LOS Reticle
3) the tip of the Velocity Vector
4) the top of the LOS Reticle

Correct answer = 3. If response = 1, 2, or 4, go to I-T13.



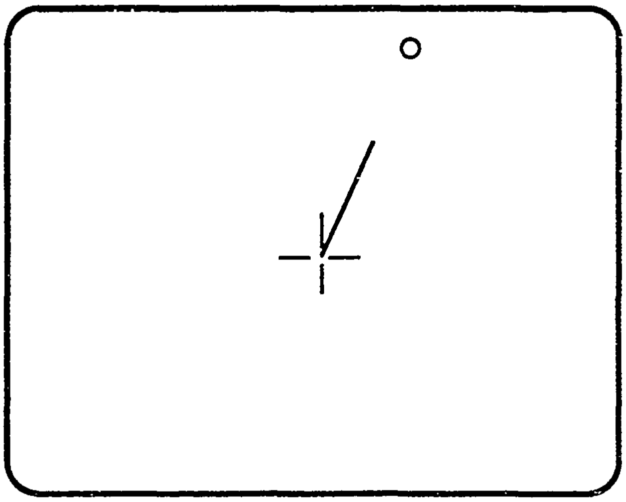
As shown in this display, if the pilot has selected the hover mode, the origin for the Acceleration Cue is:
1) the center of the LOS Reticle
2) the bottom of the LOS Reticle
3) the tip of the Velocity Vector
4) the top of the LOS Reticle

Correct answer = 1. If response = 2, 3, or 4, go to I-T18.



If the pilot has selected the transition mode, the display shown above indicates that the helicopter is:
1) moving at a constant ground speed of approximately 3 knots
2) accelerating at a ground speed of approximately 3 knots
3) moving at a constant ground speed of approximately 30 knots
4) accelerating at a ground speed of approximately 30 knots

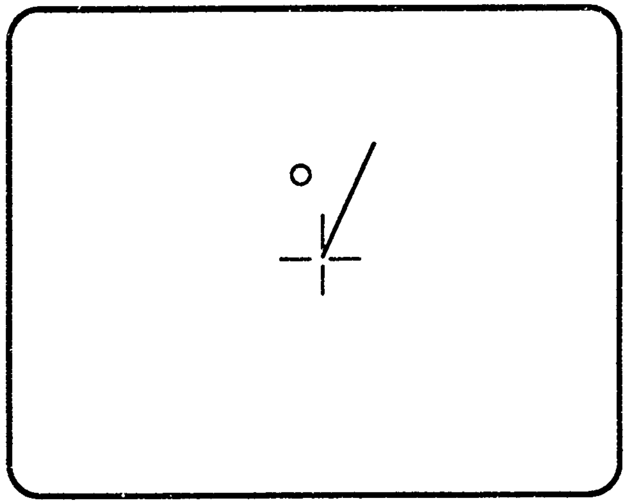
Correct answer = 3. If response = 1, 2, or 4, go to I-T9, I-T16.



If the Acceleration Cue remains in the position shown in this display, the helicopter will:

1) move forward and to the left at a constant velocity
2) move forward and to the right at a constant velocity
3) decelerate forward and to the left
4) accelerate forward and to the right

Correct answer = 4. If response = 1, 2, or 3, go to I-T10, I-T15.



If the Acceleration Cue remains in the position shown in this display, the helicopter will:

1) accelerate and move to the left
2) decelerate and move to the left
3) accelerate and move to the right
4) decelerate and move to the right

Correct answer = 2. If response = 1, 3, or 4, go to I-T17.

**No
Display
Shown**

In the transition mode, once the Velocity Vector has reached its maximum length, the point of origin of the Acceleration Cue will:

1) be the tip of the Velocity Vector
2) be the center of the LOS Reticle
3) switch from the tip of the Velocity Vector to the center of the LOS Reticle
4) switch from the center of the LOS Reticle to the tip of the Velocity Vector

Correct answer = 1. If response = 2, 3, or 4, go to I-T20.

I-Q13

No
Display
Shown

The Acceleration Cue (along with the Velocity Vector) flashes when:
1) the HARS is in free inertial
2) the ADSS has failed
3) the Velocity Vector is at its maximum length
4) the Hover Position Box is centered over the LOS Reticle

Correct answer = 1. If response = 2, 3, or 4, go to I-T20.

I-Q14

No
Display
Shown

The symbol that is known as a "motion anticipator" is the:
1) LOS Reticle
2) Velocity Vector
3) Acceleration Cue
4) Hover Position Box

Correct answer = 3. If response = 1, 2, or 4, go to I-T14.

I-Q15

No Display Shown

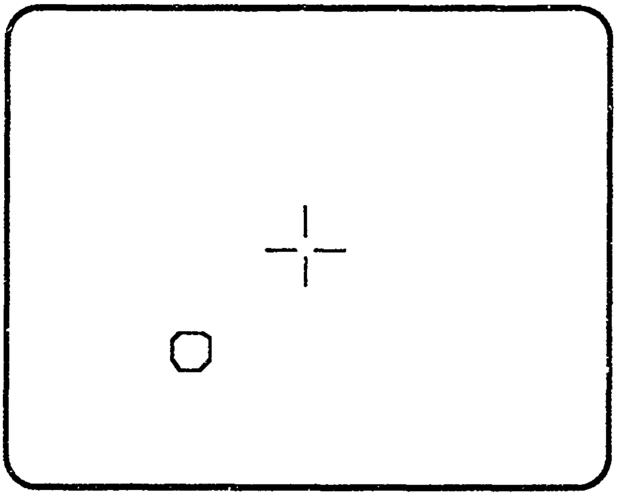
The Hover Position Box represents the position on the ground over which:
1) the helicopter was hovering when the bob-up mode was selected
2) the helicopter was hovering when the hover mode was selected
3) the helicopter was hovering when the transition mode was selected
4) the helicopter is presently hovering

Correct answer = 1. If response = 2, 3, or 4, go to I-T22.

No
Display
Shown

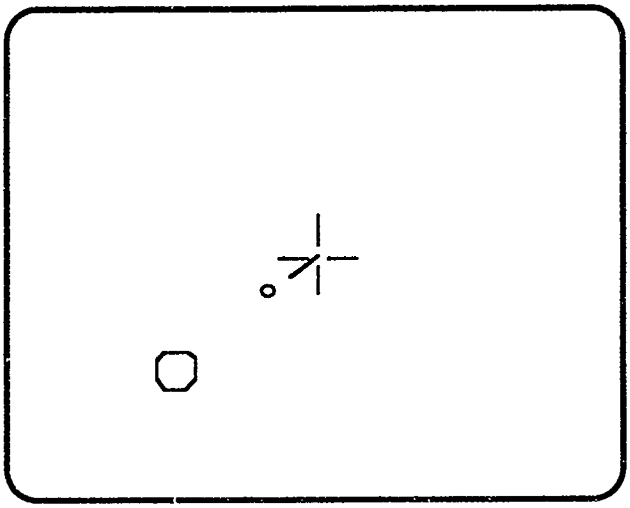
The Hover Position Box is shown:
1) only in the hover mode of symbology
2) only in the bob-up mode of symbology
3) in both the hover and the bob-up modes of symbology
4) in both the transition and cruise modes of symbology

Correct answer = 2. If response = 1, 3, or 4. go to I-T22.



The location of the Hover Position Box in this display indicates that the pilot should fly in what direction to be over the ground position at which the bob-up mode was initiated?
1) forward and to the left
2) forward and to the right
3) rearward and to the left
4) rearward and to the right

Correct answer = 3. If response = 1, 2, or 4, go to I-T25.



According to the display shown above, what would the pilot do to return to the position at which the bob-up mode was selected?
1) keep the cyclic at its present position
2) move the cyclic so that the Acceleration Cue is halfway between the tip of the Velocity Vector and the Hover Position Box
3) move the cyclic so that the Acceleration Cue is in the center of the LOS Reticle
4) move the cyclic so that the Acceleration Cue is in the center of the Hover Position Box

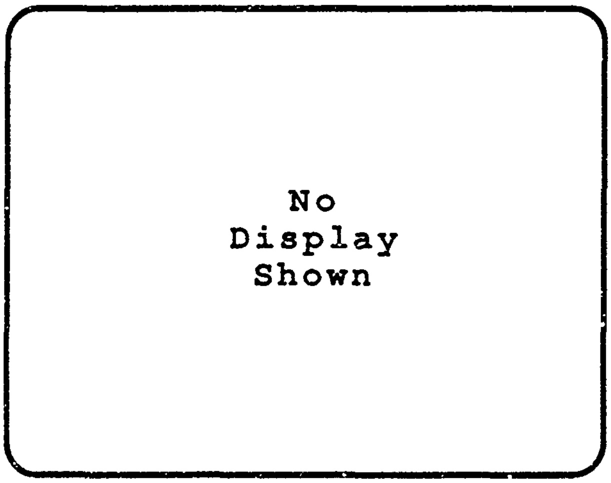
Correct answer = 2. If response = 1, 3, or 4, go to I-T26.

No
Display
Shown

Once the pilot has returned to the position at which the bob-up mode was initiated, the Hover Position Box will:

1) flash
2) blank
3) be centered on the LOS Reticle
4) turn from solid to dashed

Correct answer = 3. If response = 1, 2, or 4, go to I-T27.



When the helicopter exceeds the lateral or longitudinal limits, the Hover Position Box will:

1) flash
2) blank
3) remain at the edge of the display, and continue to indicate the place that the bob-up mode was initiated
4) remain at the edge of the display, but will no longer provide valid information to the pilot

Correct answer = 3. If response = 1, 2, or 4, go to I-T28.

I-Q21

No
Display
Shown

The Hover Position Box blanks when:
1) the LDNS has failed
2) the HARS has failed
3) the helicopter returns to the ground position at which the bob-up mode was selected
4) the helicopter returns to the ground position at which the hover mode was selected

Correct answer = 2. If response = 1, 3, or 4, go to I-T29.

APPENDIX B

SYMBOLOGY TUTOR STORYBOARDS FOR LESSON 2: ATTITUDE/ALTITUDE SYMBOLS

Lesson 2

Attitude/Altitude Symbols

The purpose of this lesson is to teach you to identify and understand the meaning of symbols in the Flight Symbology set that give the pilot information about the attitude and altitude of the helicopter.

The specific symbols covered in this lesson are:

- The Engine Torque Digital Readout
- The Radar Altitude Digital Readout
- The Radar Altitude Vertical Tape and Scale
- The Rate of Climb Indicator and Scale
- The Horizon Line
- The Skid/Slip Ball and Skid/Slip Lubber Lines

The word "green" is shown in the color green; the word "blue" is shown in the color blue.

This lesson is divided into two parts: A Tutorial and a Quiz.

Tutorial

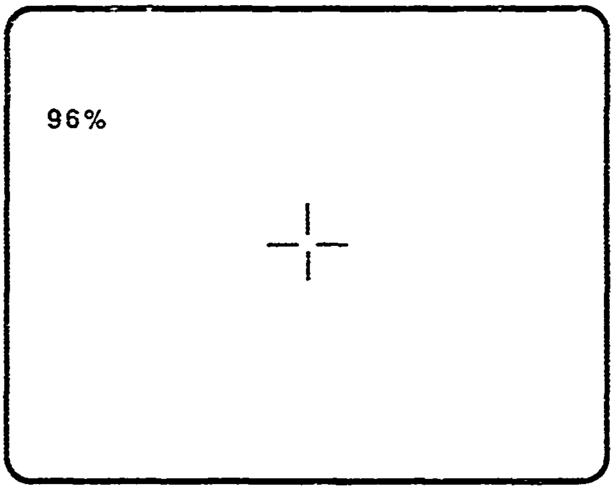
In the first part, a facsimile of an AH-64 visual display showing one symbol or a small group of symbols is shown on the top part of the screen. The symbol or symbols of interest are highlighted in **green** and described briefly below the display. Supplementary material that does not appear on the AH-64 display is shown in **blue**. In some cases, you will have the opportunity to see a brief demonstration of how the symbol or symbols move in the display.

The Line of Sight (LOS) Reticle (covered in Lesson 1) is included on the Tutorial displays to provide a general frame of reference.

Quiz

The second part of this lesson consists of a quiz covering the material you have just learned. If you answer a question incorrectly, you will briefly review the material covered in that question before proceeding with the quiz. After you have completed the quiz, you will have the opportunity to review the lesson again, go on to another lesson, or quit the program.

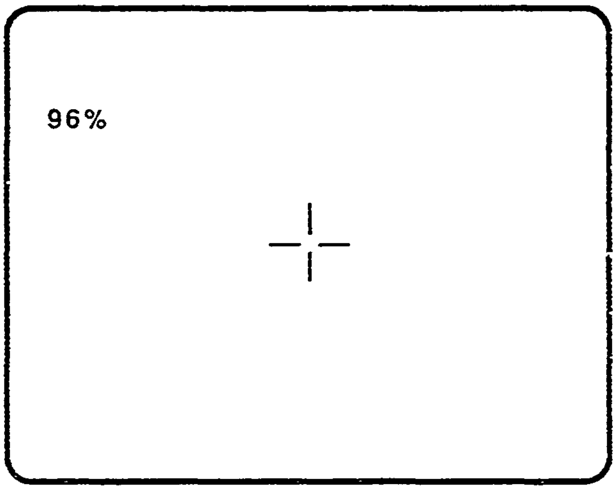
Engine Torque Digital Readout symbol is highlighted in green.



This is the **Engine Torque Digital Readout**

It shows the amount of torque that the highest torque engine is producing.

Engine Torque Digital Readout is highlighted in green.



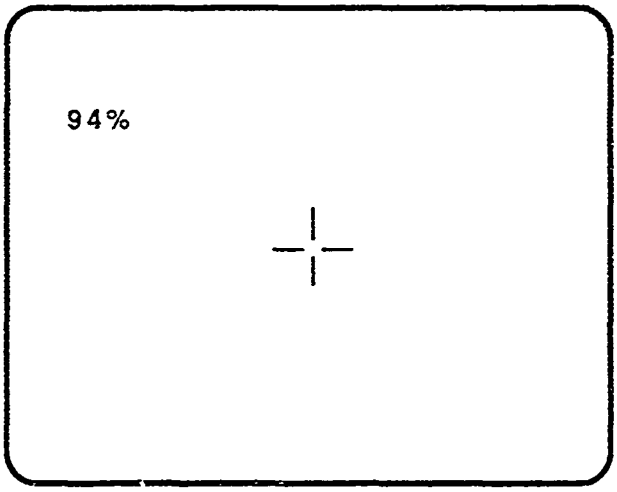
If there is a torque split between the two engines greater than 12%, the displayed torque value flashes.

Press spacebar to simulate an engine torque split greater than 12%.

Engine Torque Digital Readout flashes at a rate of .75 sec on/.25 sec off.

Press spacebar to see demonstration again.

Engine Torque Digital Readout is highlighted in green.



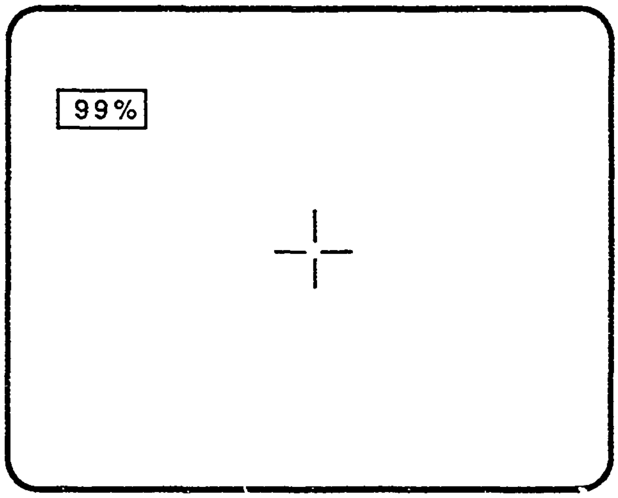
When torque pressure increases to 98%, the Engine Torque Digital Readout is surrounded by a flashing rectangle to alert the pilot of an impending engine torque limit.

Press spacebar to simulate engine torque pressure increasing beyond 98%.

Engine Torque Digital Readout increases from 94% to 99% in increments of 1% at rate of two changes per second. When Readout reaches 98%, rectangle surrounding the Engine Torque Digital Readout is shown in green and flashes at rate of .3 sec on/.2 sec off.

Press spacebar to see demonstration again.

Engine Torque Digital Readout and rectangle surrounding Engine Torque Digital Readout are highlighted in green; rectangle flashes at rate of .3 sec on/.2 sec off.



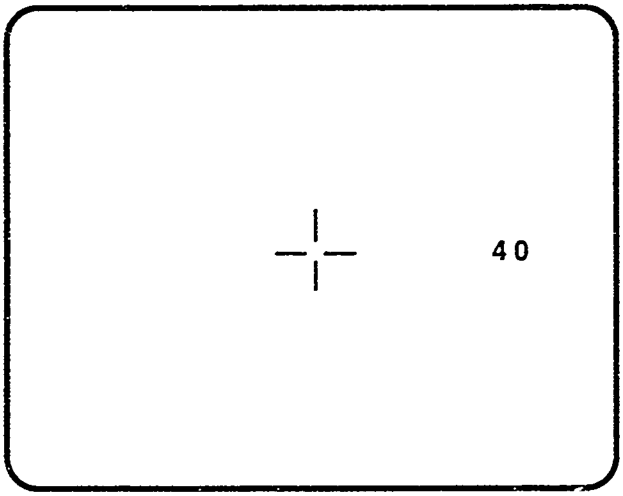
As the torque value is reduced to 94%, the flashing rectangle is removed from the display.

Press spacebar to simulate engine torque pressure decreasing below 94%.

Engine Torque Digital Readout value decreases, in increments of 1%, from 99% to 93% at rate of two changes per second. When the Readout reaches 94%, the flashing rectangle disappears from the display.

Press spacebar to see demonstration again.

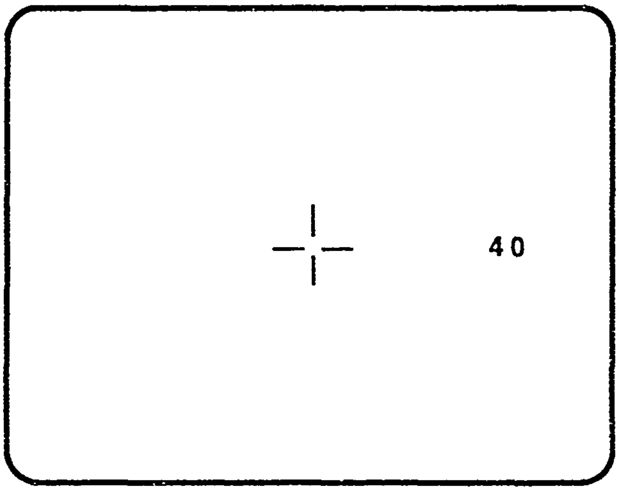
Radar Altitude Digital Readout is highlighted in green.



This is the **Radar Altitude Digital Readout.**

It shows the altitude of the helicopter above the ground in feet, <u>from 0 to 1,500 feet</u> above ground level (AGL).

Radar Altitude Digital Readout is highlighted in green.



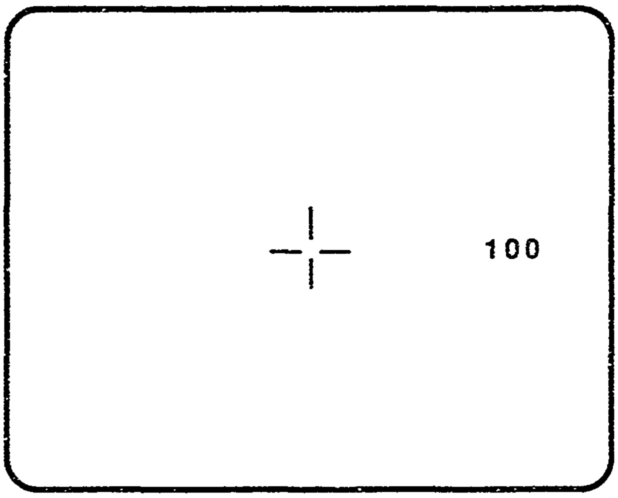
Absolute altitude is displayed in 1-foot increments when the helicopter is between 0 and 50 feet AGL.

Press spacebar for demonstration.

Radar Altitude Digital Readout increases in 1-foot increments, at rate of two changes per second, from 40 feet to 50 feet.

Press spacebar to see demonstration again.

Radar Altitude Digital Readout is highlighted in green.



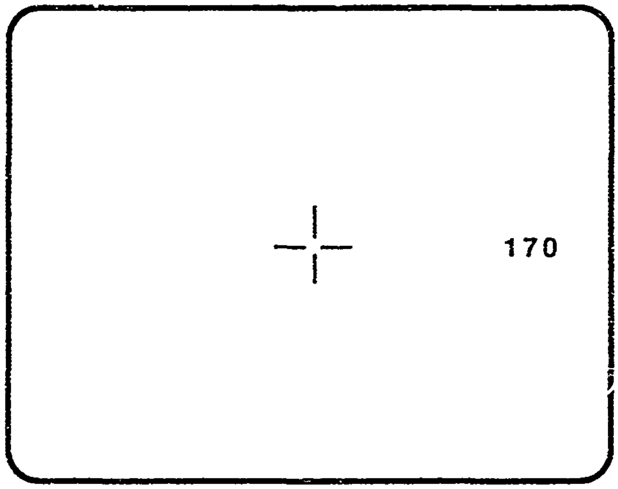
Absolute altitude is displayed in 10-foot increments when the helicopter is between 50 and 1,500 feet AGL.

Press spacebar for demonstration.

Radar Altitude Digital Readout increases in 10-foot increments, at rate of one change per second, from 100 feet to 150 feet.

Press spacebar to see demonstration again.

Nothing is highlighted in green.



The alert message "HI" flashes above the Digital Radar Altitude if the helicopter's altitude AGL is above the altitude chosen on the radar altimeter HI set knob.

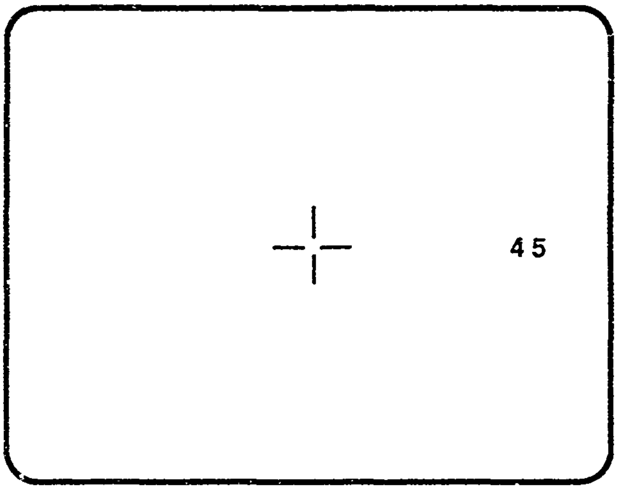
In this case, the HI setting on the radar altimeter is 200 feet.

Press spacebar to simulate the helicopter climbing above 200 feet.

Radar Altitude Digital Readout increases in 10-foot increments, at rate of one change per second, from 170 feet to 220 feet. After Readout exceeds 200 feet, "HI" alert message is shown in green and flashes at rate of .3 sec on/.2 sec off.

Press spacebar to see demonstration again.

Nothing is highlighted in green.



The alert message "LO" flashes below the Digital Radar Altitude if the helicopter's altitude AGL is below the altitude chosen on the radar altimeter LO set knob.

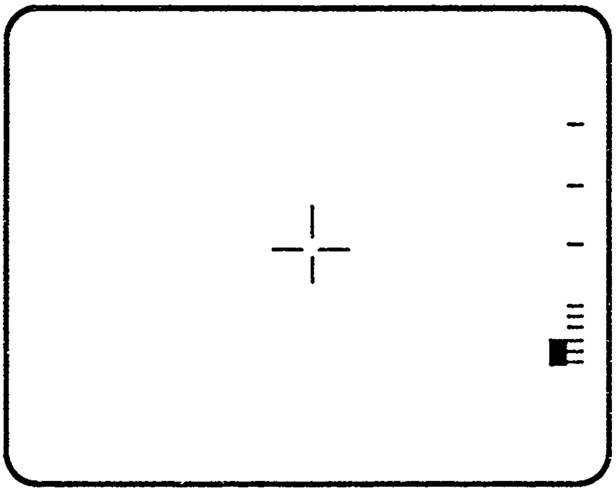
In this case, the LO setting on the radar altimeter is 40 feet.

Press spacebar to simulate helicopter descending below 40 feet.

Radar Altitude Digital Readout decreases from 45 feet to 35 feet in 1-foot increments, at rate of two changes per second. When Readout goes below 40 feet, "LO" alert message is shown in green and flashes at rate of .3 sec on/.2 sec off.

Press spacebar to see demonstration again.

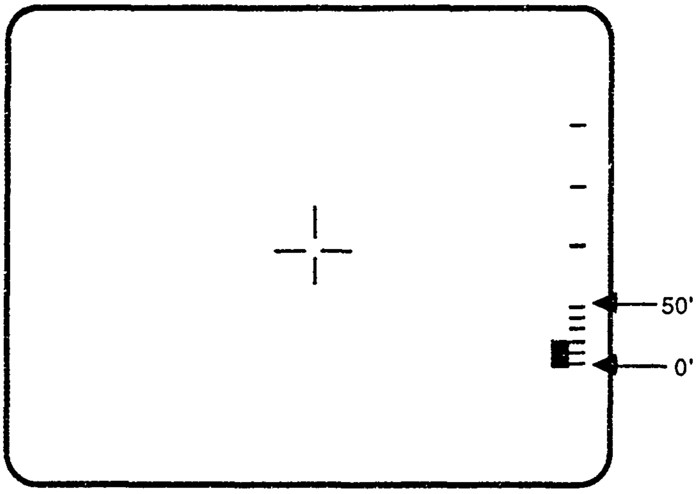
Radar Altitude Vertical Tape and Scale are highlighted in green.



This is the **Radar Altitude Vertical Tape and Scale.**

The Radar Altitude Vertical Tape is an analog representation of the helicopter's altitude AGL in feet in reference to the Radar Altitude Vertical Scale.

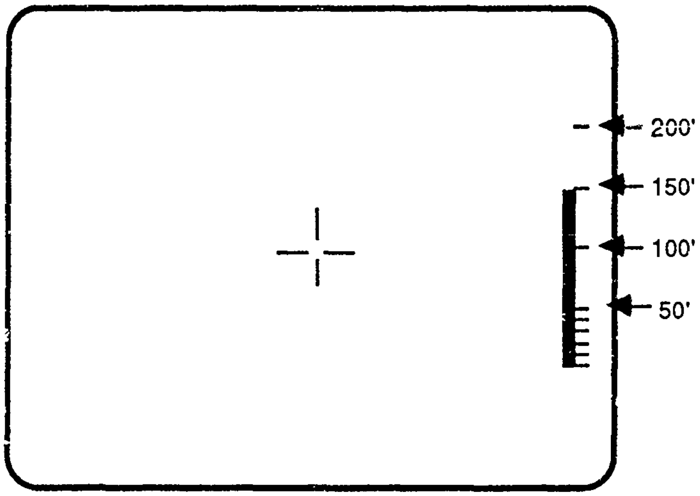
0- to 50-foot section of the Radar Altitude Vertical Scale, and all of the Radar Altitude Vertical Tape are highlighted in green; numbers and arrows outside the display are shown in blue.



The Radar Altitude Vertical Scale is graduated in 10 foot increments from 0 to 50 feet AGL.

For example, the display shown above indicates that the heliccpter is at 20' AGL.

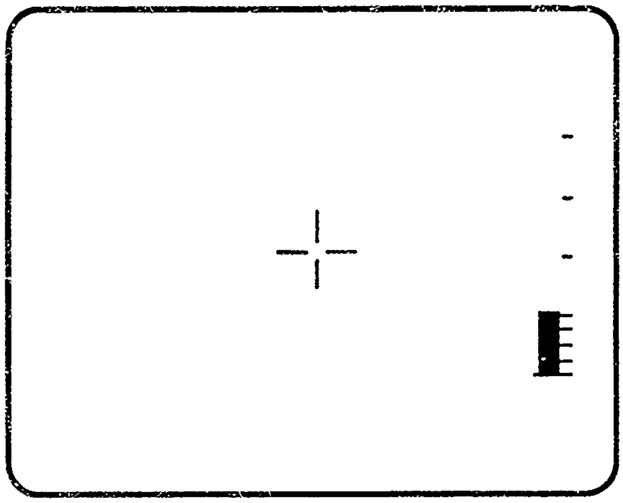
50- to 200-foot section of Radar Altitude Vertical Scale, and all of the Radar Altitude Vertical Tape are highlighted in green; numbers and arrows outside the display are shown in blue.



The Radar Altitude Vertical Scale is graduated in 50 foot increments from 50 to 200 feet AGL.

For example, the display shown above indicates that the helicopter is at 150 feet AGL.

Radar Altitude Vertical Tape and Scale are highlighted in green.



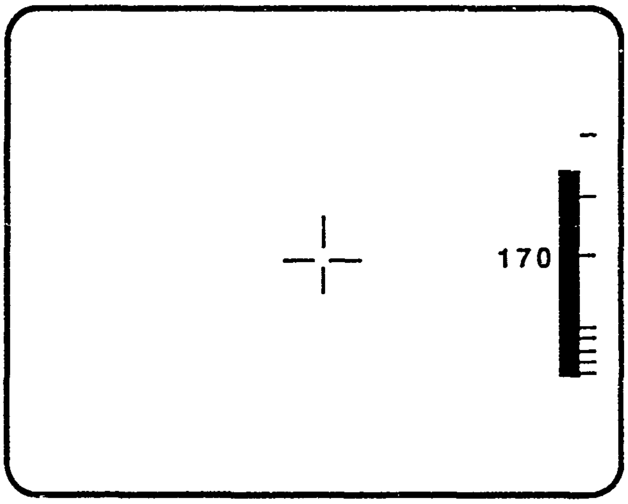
The direction and relative change in altitude are graphically indicated by the direction and rate of movement of the Radar Altitude Vertical Tape.

Press spacebar for demonstration.

Radar Altitude Vertical Tape starts at 50 feet, increases to 150 feet in 2 seconds, and then decreases to 100 feet in 1 second.

Press spacebar to see demonstration again.

Radar Altitude Vertical Tape and Scale are highlighted.



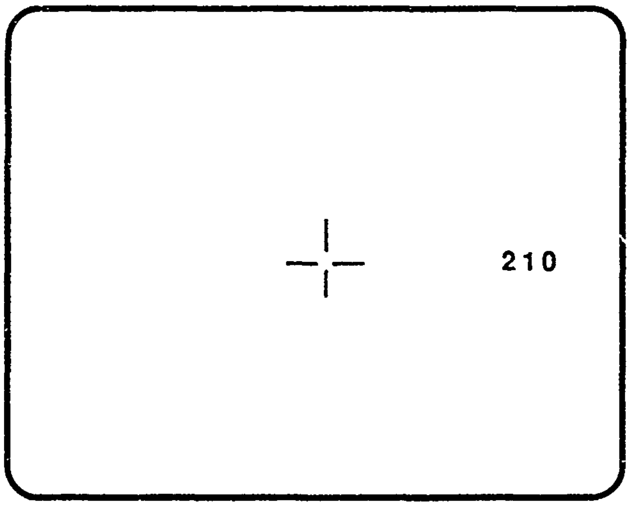
The Radar Altitude Vertical Tape and Scale disappears when the helicopter climbs to 200 feet AGL.

Press spacebar to simulate helicopter climbing above 200 feet AGL.

Radar Altitude Digital Readout increases from 170 feet to 200 feet, in 10-foot increments, at rate of one change per second. Radar Altitude Vertical Tape increases accordingly. When Tape reaches 200-foot tick mark, Radar Altitude Vertical Tape and Scale disappear from the display. Readout continues to increase to 220 feet.

Press spacebar to see demonstration again.

Nothing is highlighted in green.



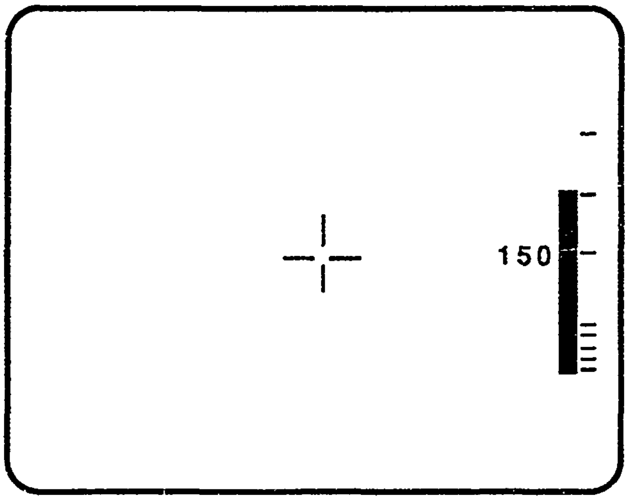
The Radar Altitude Vertical Tape and Scale reappears when the helicopter descends to 180 feet AGL.

Press spacebar to simulate helicopter descending below 180 feet.

Radar Altitude Digital Readout starts at 210 feet and decreases to 180 feet in 10 foot increments, at rate of one change per second. When Readout reaches 180 feet, Radar Altitude Vertical Tape and Scale reappear on display and are shown in green. Readout continues to decrease to 160 feet. Tape decreases accordingly.

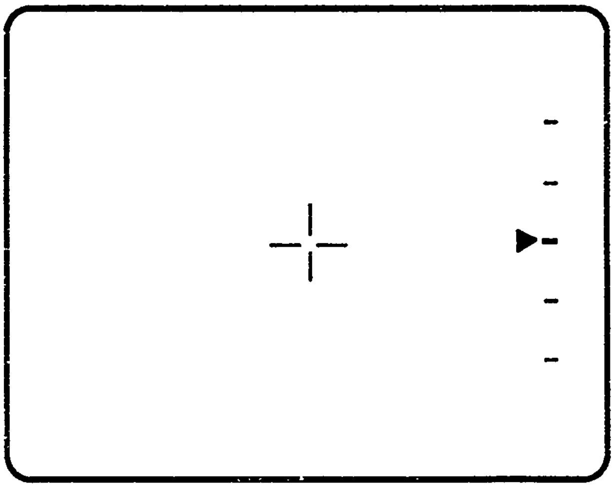
Press spacebar to see demonstration again.

Radar Altitude Vertical Tape and Scale are highlighted in green.



The Radar Altitude Vertical Tape and Scale are driven by the radar altimeter when the altitude data are valid.

Rate of Climb Indicator and Scale are highlighted in green.

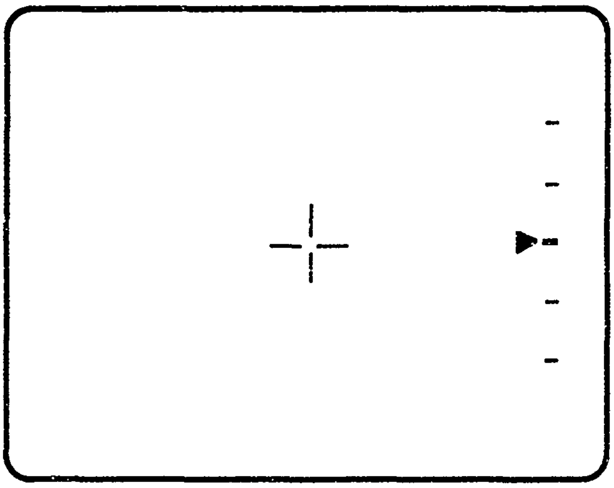


This is the **Rate of Climb Indicator and Scale.**

The Rate of Climb Indicator shows the helicopter's rate of climb or descent in reference to the Rate of Climb Scale.

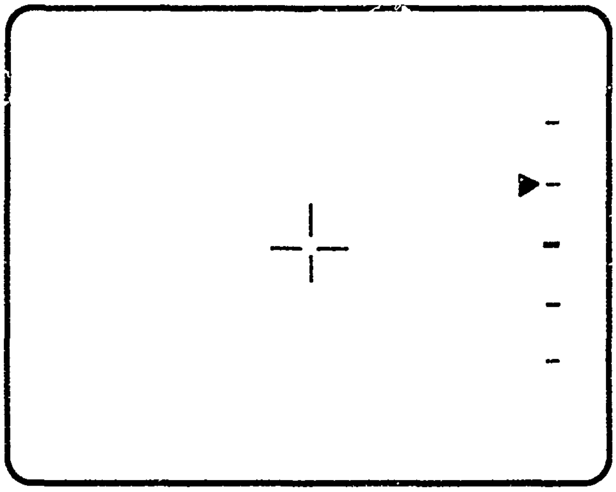
The Rate of Climb Scale is graduated in units of 500 feet.

Only the center tick mark of the Rate of Climb Scale is highlighted in green.



The center tick mark of the Rate of Climb Scale indicates <u>zero</u> rate of climb.

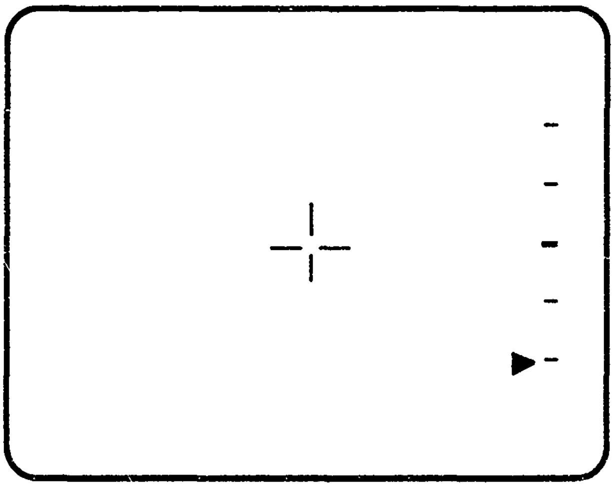
Only the upper two tick marks of the Rate of Climb Scale are highlighted in green.



The two tick marks above the center tick mark indicate 500 and 1000 foot-per-minute rates of climb.

For example, the Rate of Climb Indicator in this display shows that the helicopter is in a 500 foot-per-minute climb.

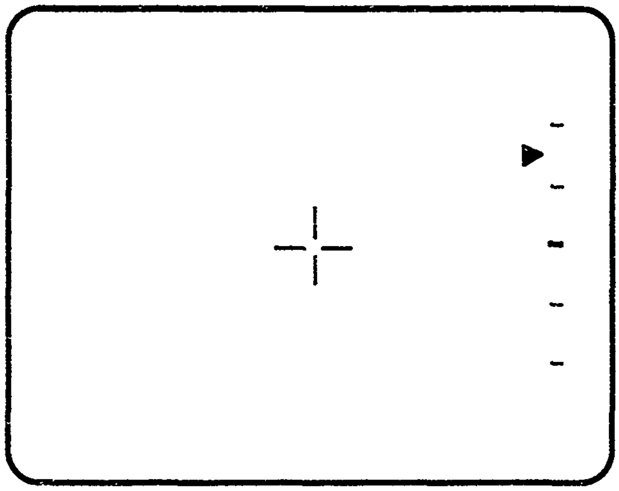
Only the lower two tick marks of the Rate of Climb Scale are highlighted in green.



The two tick marks below the center tick mark indicate 500 and 1000 foot-per-minute rates of descent.

For example, the Rate of Climb Indicator in this display shows that the helicopter is in a 1,000 foot-per-minute descent.

The Rate of Climb Indicator is highlighted.



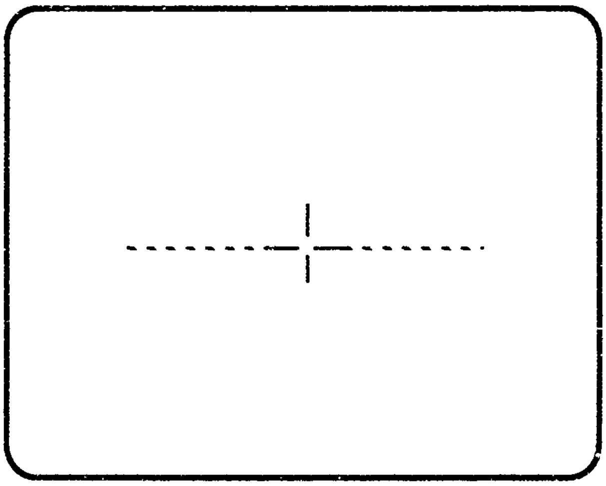
If the doppler data is invalid, the Rate of Climb Indicator remains fixed at the center of the Rate of Climb Scale.

Press spacebar to simulate invalid doppler data.

Indicator moves to center tick mark in about one second.

Press spacebar to see demonstration again.

The Horizon Line is highlighted in green.

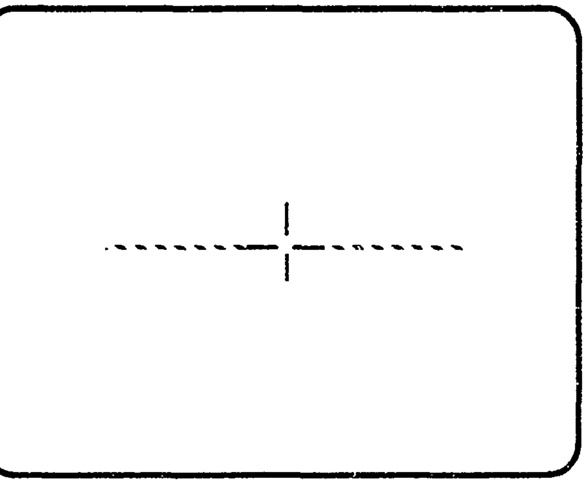


This is the **Horizon Line.**

It shows the pitch and roll attitude of the helicopter with respect to the LOS Reticle, which represents the nose and wings of the helicopter.

The Horizon Line is shown only in the transition and cruise modes of flight.

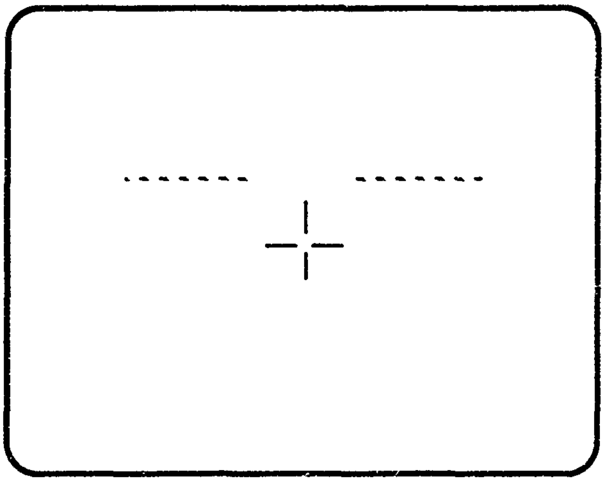
The Horizon Line is highlighted in green.



The Horizon Line is adjustable in pitch and roll by controls located on the visual display unit (VDU).

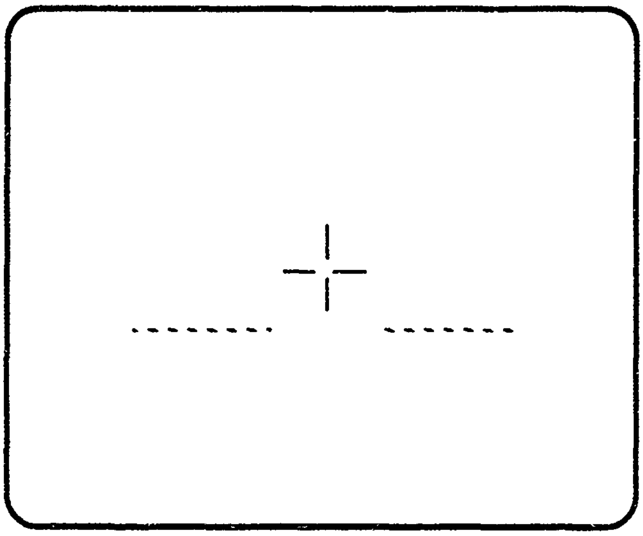
The Horizon Line on this display indicates that the nose and wings of the helicopter are even with the horizon.

The Horizon Line is highlighted in green.



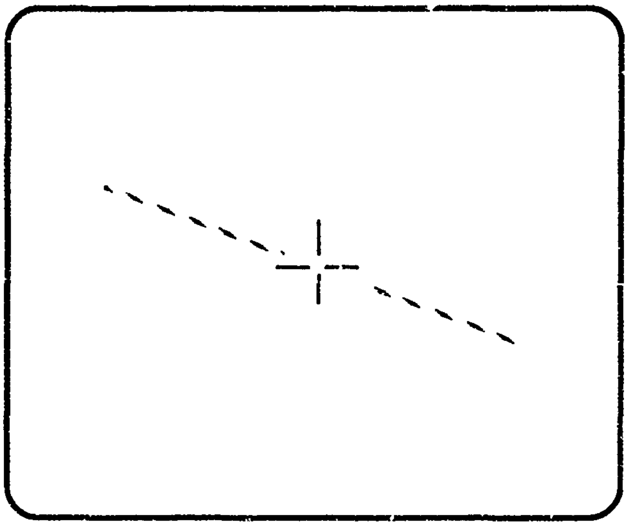
The Horizon Line in this display indicates that the nose of the helicopter is below the horizon, and that the wings are level with the horizon.

The Horizon Line is highlighted in green.



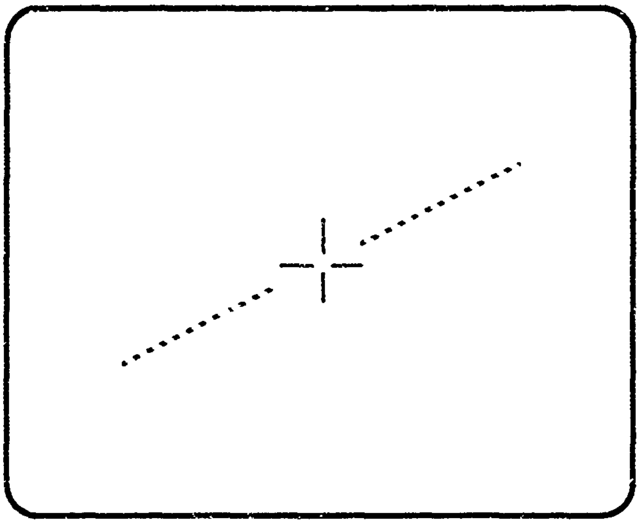
The Horizon Line in this display indicates that the nose of the helicopter is above the horizon, and that the wings are level with the horizon.

The Horizon Line is highlighted in green.



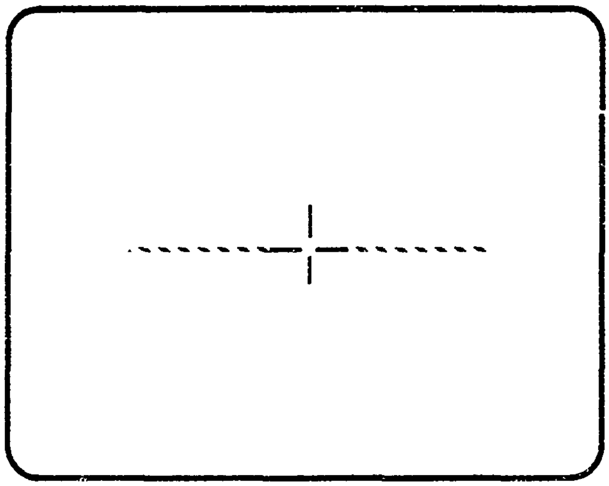
The Horizon Line in this display indicates that the helicopter is in a level left turn.

The Horizon Line is highlighted in green.



The Horizon Line in this display indicates that the helicopter is in a level right turn.

The Horizon Line is highlighted in green.



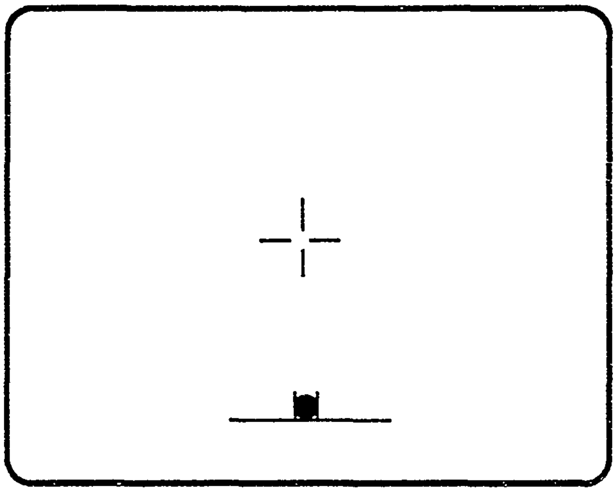
The Horizon Line is driven by the Heading and Attitude Reference System (HARS) and will blank if the HARS fails.

Press spacebar to simulate HARS failure.

After 1 second the Horizon Line disappears from the display.

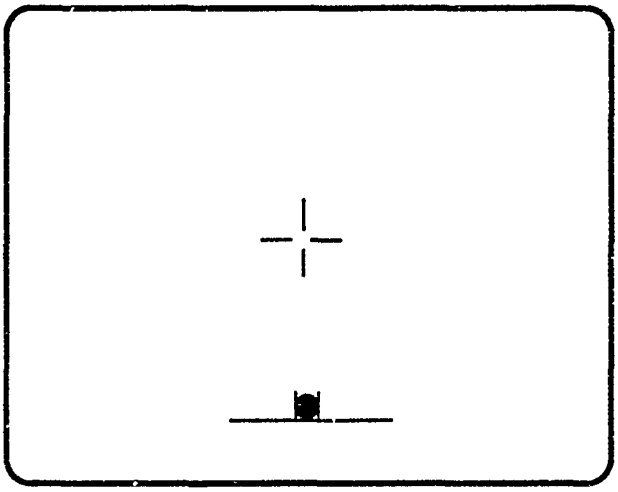
Press spacebar to see demonstration again.

The Skid/Slip Ball and Skid/Slip Lubber Lines are highlighted in green. Horizontal line below Skid/Slip ball is shown in white.



These are the **Skid/Slip Ball and Skid/Slip Lubber Lines.** The Skid/Slip Ball indicates the amount of side force that the helicopter is experiencing, in reference to the Skid/Slip Lubber Lines.

The Skid/Slip Lubber Lines are highlighted in green.



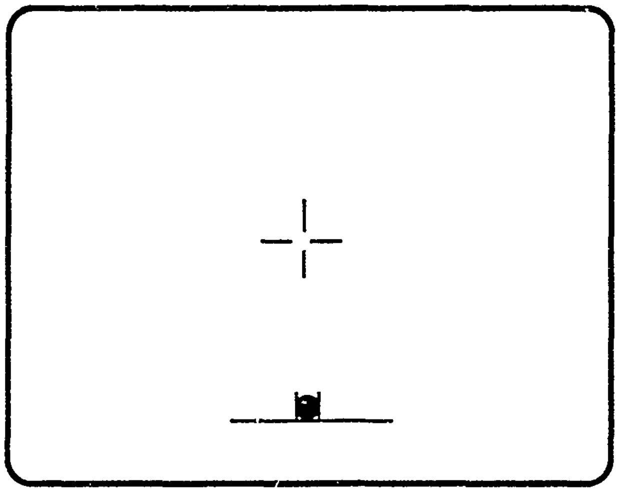
The Skid/Slip Lubber Lines show the limits of "ball-centered" flight, and are a reference for the Skid-Slip Ball.

Press spacebar for demonstration.

Skid/Slip Ball moves one-half ball width to the left in 1 second, back to center in 1 second, and one-half ball width to the right in 1 second, then back to center in 1 second.

Press spacebar to see demonstration again.

The Skid/Slip Ball is highlighted in green.



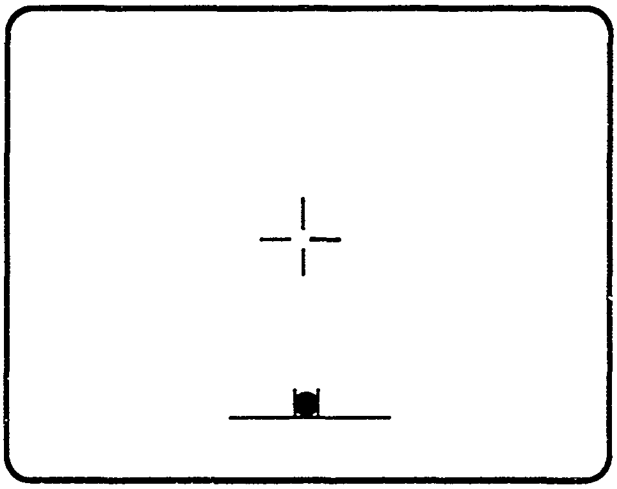
One quarter (1/4) of a G of lateral acceleration provides full displacement of the Skid/Slip Ball to the left or to the right.

Press spacebar to simulate helicopter experiencing 1/4 of a G of acceleration.

The Skid/Slip Ball starts at the center and moves to the left-most part of the horizontal line in 2 seconds, returns to center in 2 seconds, then moves to the right-most part of the horizontal line in 2 seconds, then returns to the center in 2 seconds.

Press spacebar to see demonstration again.

The Skid/Slip Ball and Skid/Slip Lubber Lines are highlighted in green.



The Skid/Slip Ball and the Skid/Slip Lubber Lines blank when the HARS is invalid.

Press spacebar to simulate a HARS failure.

After 1 second, the Skid/Slip Ball and the Skid/Slip Lubber Lines disappear from the display. LOS Reticle and horizontal line below Skid/Slip Ball remain on the display.

Press spacebar to see demonstration again.

You have now completed the lesson on Attitude/Altitude Symbols.

Please select what you would like to do now:

- Take the Quiz
- Returr. to the Main Menu

Symbology Tutor Quiz - Lesson 2: Attitude/Altitude Symbols

This quiz tests how much you learned about the Attitude/Altitude Symbols presented in Lesson 2. The quiz consists of 22 multiple choice questions. Each answer has a small box associated with it. You will see a cross-shaped pointer just below the question and above the answer boxes. Use the arrow keys on the numeric keypad to move the pointer to the box next to your answer, then press ENTER to confirm your answer. You must answer each question correctly one time before you may leave the quiz.

Press ENTER to begin the quiz.

II-Q1

No
Display
Shown

The Engine Torque Digital Readout indicates:

1) the amount of torque that the highest torque engine is producing
2) the amount of torque that the lowest torque engine is producing
3) a weighted average of the amount of torque produced by the two engines
4) an unweighted average of the amount of torque produced by the two engines

Correct answer = 1. If response = 2, 3, or 4, go to II-T1.

No
Display
Shown

The Engine Torque Digital Readout is located:
1) on the left side and center of the display
2) on the left side and top of the display
3) on the right side and center of the display
4) on the right side and top of the display

Correct answer = 2. If response = 1, 3, or 4, go to II-T1.

**No
Display
Shown**

The Engine Torque Digital Readout flashes when:
1) torque pressure on the highest torque engine is 98% or higher
2) torque pressure on the highest torque engine is 100% or higher
3) a torque split between the two engines is greater than 6%
4) a torque split between the two engines is greater than 12%

Correct answer = 4. If response = 1, 2, or 3, go to II-T2.

II-Q4

No Display Shown

The Engine Torque Digital Readout is surrounded by a flashing rectangle when:

1) torque pressure on the highest torque engine is 98% or higher
2) torque pressure on the highest torque engine is 100% or higher
3) a torque split between the two engines is greater than 6%
4) a torque split between the two engines is greater than 12%

Correct answer = 1. If response = 2, 3, or 4, go to II-T3.

II-Q5

No Display Shown

The flashing rectangle surrounding the Engine Torque Digital Readout is removed from the display when:
1) torque pressure on the highest torque engine is reduced to 90%
2) torque pressure on the highest torque engine is reduced to 94%
3) a torque split between the two engines is reduced to 10%
4) a torque split between the two engines is reduced to 6%

Correct answer = 2. If response = 1, 3, or 4, go to II-T4.

No
Display
Shown

The Radar Altitude Digital Readout is located:
1) on the left side and center of the display
2) on the left side and top of the display
3) on the right side and center of the display
4) on the right side and top of the display

Correct answer = 3. If response = 1, 2, or 4, go to II-T5.

No Display Shown

The Radar Altitude Digital Readout is displayed in 10-foot increments between:
1) 0 feet and 50 feet AGL
2) 0 feet and 100 feet AGL
3) 50 feet and 1,500 feet AGL
4) 50 feet and 2,000 feet AGL

Correct answer = 3. If response = 1, 2, or 4, go to II-T7.

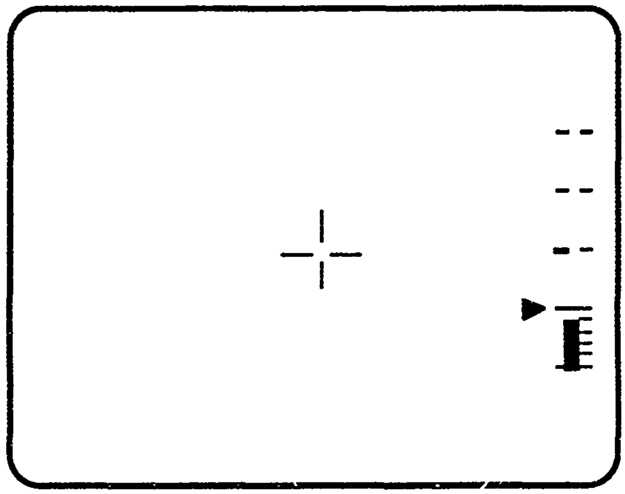
II-Q8

No
Display
Shown

Which of the following statements about the Radar Altitude Vertical Scale is true?

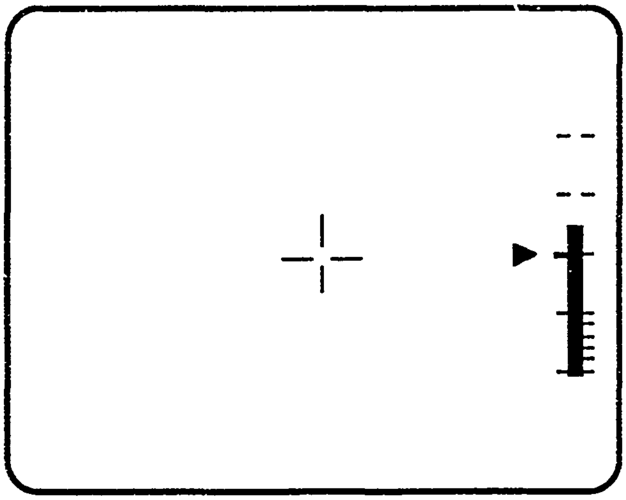
1) It is graduated in 5 foot increments from 0 to 50 feet
2) It is graduated in 10 foot increments from 0 to 50 feet
3) It is graduated in 10 foot increments from 0 to 200 feet
4) It is graduated in 50 foot increments from 100 to 200 feet

Correct answer = 4. If response = 1, 2, or 3, go to II-T11.



As shown in this display, the helicopter is at approximately what altitude?
1) 20 feet AGL
2) 30 feet AGL
3) 40 feet AGL
4) 50 feet AGL

Correct answer = 3. If response = 1, 2, or 4, go to II-T11.



As shown in this display, the Radar Altitude Vertical Tape indicates that the helicopter is at approximately what altitude?
1) 50 feet AGL
2) 75 feet AGL
3) 100 feet AGL
4) 125 feet AGL

Correct answer = 4. If response = 1, 2, or 3, go to II-T12.

**No
Display
Shown**

The Radar Altitude Vertical Tape and Scale blanks when the helicopter climbs to what altitude?
1) 150 feet AGL
2) 180 feet AGL
3) 200 feet AGL
4) 250 feet AGL

Correct answer = 3. If response = 1, 2, or 4, go to II-T14.

II-Q12

No
Display
Shown

After the Radar Altitude Vertical Scale goes blank, it reappears when the helicopter descends to what altitude?
1) 150 feet AGL
2) 180 feet AGL
3) 200 feet AGL
4) 250 feet AGL

Correct answer = 2. If response = 1, 3, or 4, go to II-T15.

II-Q13

No Display Shown

The Radar Altitude Vertical Tape and Scale are driven by the:
1) LDNS
2) HARS
3) ADSS
4) Radar Altimeter

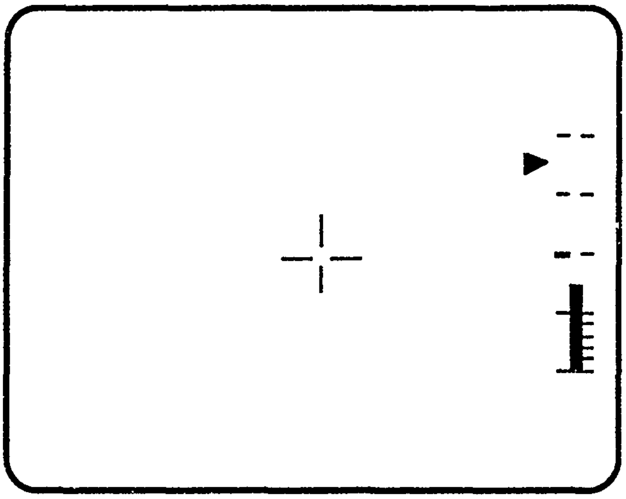
Correct answer = 4. If response = 1, 2, or 3, go to II-T16.

II-Q14

**No
Display
Shown**

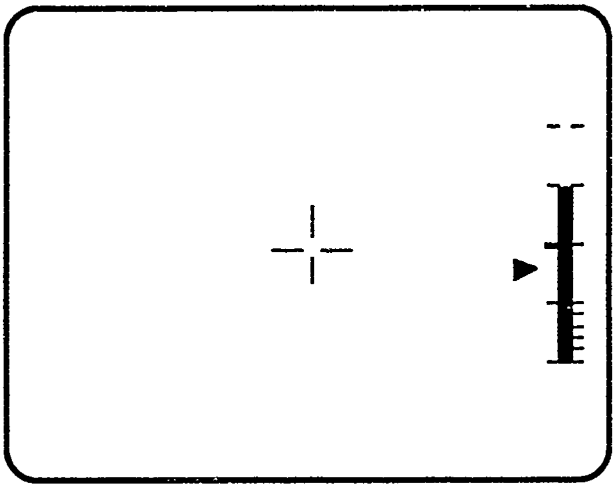
The Rate of Climb Scale is graduated in units of:
1) 100 feet
2) 200 feet
3) 500 feet
4) 1,000 feet

Correct answer = 3. If response = 1, 2, or 4, go to II-T17.



As shown in this display, the helicopter is in a:
1) 75 foot-per-minute climb
2) 750 foot-per-minute climb
3) 75 foot-per-minute descent
4) 750 foot-per-minute descent

Correct answer = 2. If response = 1, 3, or 4, go to II-T19.



As shown in this display, the helicopter is in a:
1) 150 foot-per-minute climb
2) 250 foot-per-minute climb
3) 150 foot-per-minute descent
4) 250 foot-per-minute descent

Correct answer = 4. If response = 1, 2, or 3, go to II-T20.

**No
Display
Shown**

If the doppler data are invalid, the Rate of Climb Indicator:
1) blanks
2) flashes
3) remains fixed at the center of the Rate of Climb Scale
4) remains fixed at the bottom of the Rate of Climb Scale

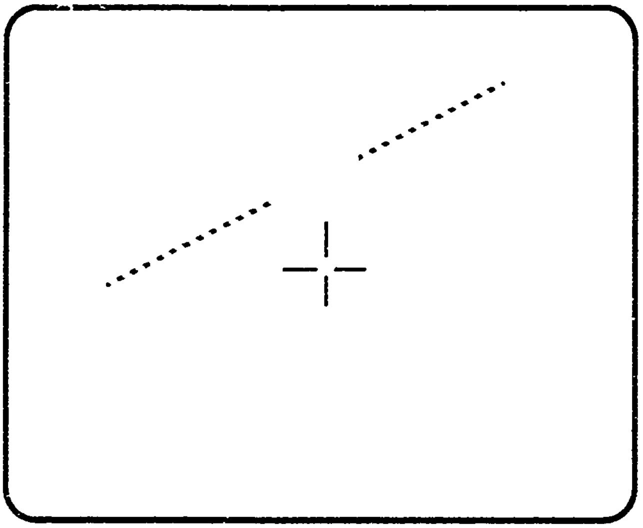
Correct answer = 3. If response = 1, 2, or 4, go to II-T21.

II-Q18

No Display Shown

In which modes of symbology will the Horizon Line be displayed?
1) the hover and bob-up modes
2) the transition and cruise modes
3) the hover, bob-up, and cruise modes
4) the hover, bob-up, and transition modes

Correct answer = 2. If response = 1, 3, or 4, go to II-T22.



As shown in this display, the helicopter is in a:
1) climbing right turn
2) descending left turn
3) climbing left turn
4) descending right turn

Correct answer = 4. If response = 1, 2, or 3, go to II-T27.

No
Display
Shown

The Horizon Line blanks when:
1) the HARS has failed
2) the ADSS has failed
3) the LDNS has failed
4) the Radar Altimeter has failed

Correct answer = 1. If response = 2, 3, or 4, go to II-T32.

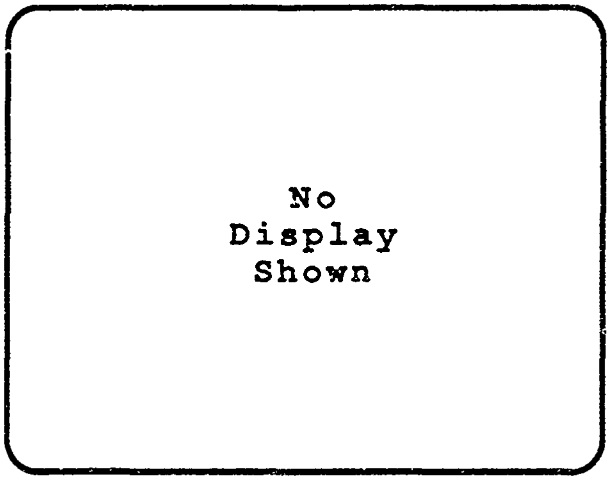
II-Q21

No Display Shown

The Skid/Slip Ball is used to show:
1) the amount of torque that the highest torque engine is producing
2) the amount of side force that the helicopter is experiencing
3) the rate at which the helicopter is climbing or descending
4) the heading of the aircraft

Correct answer = 2. If response = 1, 3, or 4, go to II-T29.

II-Q22



The Skid/Slip Ball and Skid/Slip Lubber Lines blank when:
1) the HARS has failed
2) the ADSS has failed
3) the LDNS has failed
4) the Radar Altimeter has failed

Correct answer = 1. If response = 2, 3, or 4, go to II-T32.

APPENDIX C

SYMBOLOGY TUTOR STORYBOARDS FOR LESSON 3: HEADING/NAVIGATION SYMBOLS

Lesson 3

Heading/Navigation Symbols

The purpose of this lesson is to teach you to identify and understand the meaning of symbols in the Flight Symbology set that give the pilot heading and navigation information.

The symbols covered in this lesson are:

- The Heading Scale and Fixed Lubber Line
- The Command Heading
- The Alternate Sensor Bearing
- The Horizon Line

The word "green" is shown in the color green; the word "blue" is shown in the color blue.

This lesson is divided into two parts: A Tutorial and a Quiz.

Tutorial

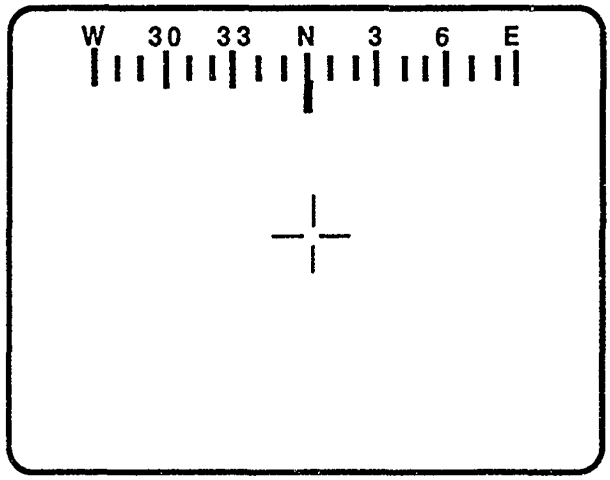
In the first part, a facsimile of an AH-64 visual display showing one symbol or a small group of symbols is shown on the top part of the screen. The symbol or symbols of interest are highlighted in **green** and described briefly below the display. Supplementary material that does not appear on the AH-64 display is shown in **blue**. In some cases, you will have the opportunity to see a brief demonstration of how the symbol or symbols move in the display.

The Line of Sight (LOS) Reticle (covered in Lesson 1) will be included on each display in the tutorial to provide a general frame of reference.

Quiz

The second part of this lesson consists of a quiz covering the material you have just learned. If you answer a question incorrectly, you will briefly review the material covered in that question before proceeding with the quiz. After you have completed the quiz, you will have the opportunity to review the lesson again, go on to another lesson, or quit the program.

The Heading Scale and Fixed Lubber Line are shown in green.

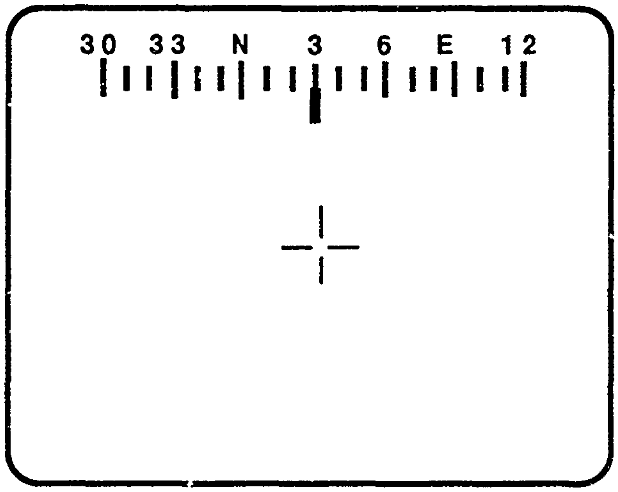


This is the **Heading Scale and Fixed Lubber Line.**

The Heading Scale moves back and forth behind the Fixed Lubber Line (which represents the nose of the helicopter) to show the magnetic heading of the helicopter.

As shown in this display, the helicopter is flying at a heading of 360.

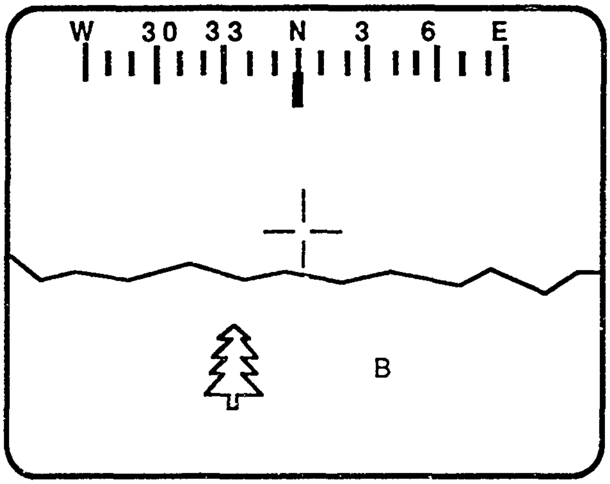
The Heading Scale is shown in green.

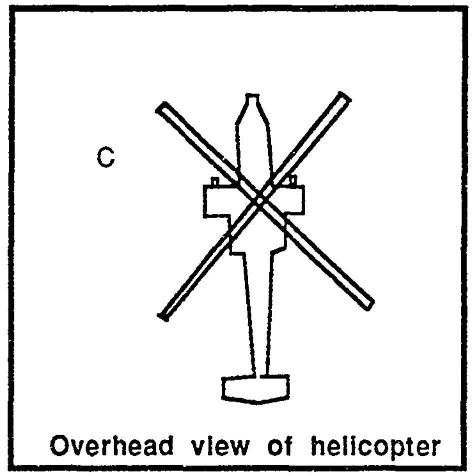


The Heading Scale shows approximately 180 degrees of heading at one time. It is graduated in major increments of 30 degrees and in minor increments of 10 degrees.

As shown in this display, the helicopter is flying at a heading of 030.

The Heading Scale is highlighted in green. Letters are not shown.





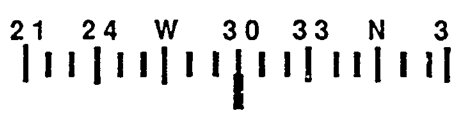
Overhead view of helicopter

The Heading Scale moves in the opposite direction that the helicopter is turning.

In this case the helicopter is turning to the left.

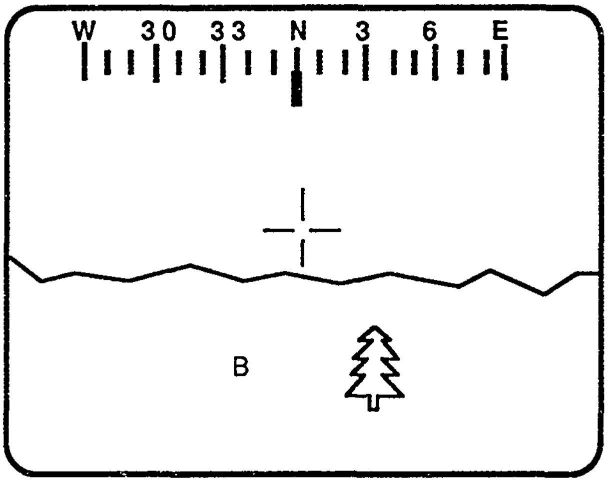
Press spacebar to simulate the helicopter turning to the left.

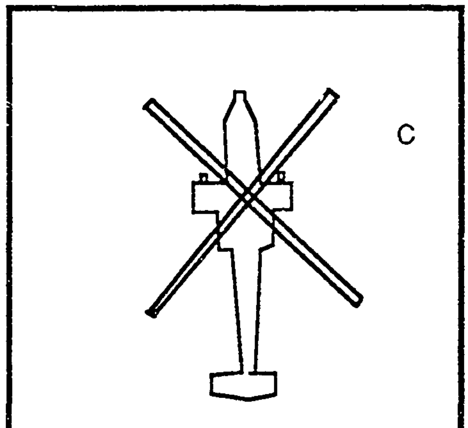
The Fixed Lubber Line remains stationary. The Heading Scale moves to the right until 300 is centered over the Fixed Lubber Line. The sequence takes approximately 5 seconds. Tree and horizon move to the right until tree is at position "B." At the same time, helicopter pivots left until nose is at position "C." Then Heading Scale looks like this:



Press spacebar to see demonstration again.

The Heading Scale is highlighted in green. Letters are not shown.



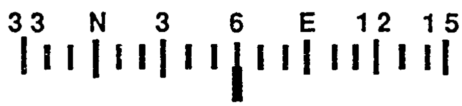


Overhead view of helicopter

In this case the helicopter is turning to the right.

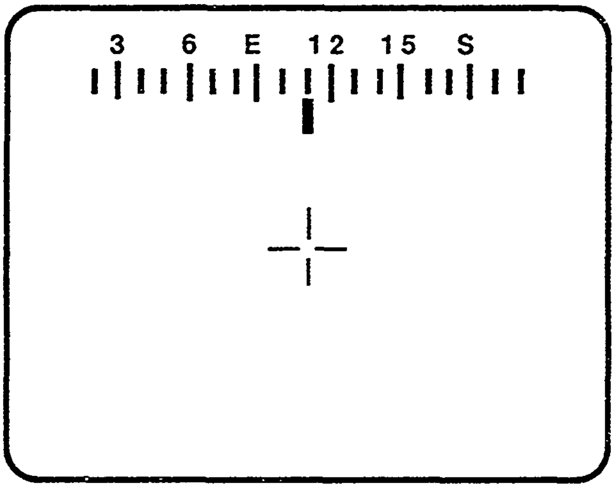
Press spacebar to simulate the helicopter turning to the right.

The Fixed Lubber Line remains stationary. The Heading Scale moves to the left until 060 is centered over the Fixed Lubber Line. The sequence takes approximately five seconds. Tree and horizon move to the left until tree is at position "B." At the same time, helicopter pivots right until nose is at position "C." Then Heading Scale looks like this:



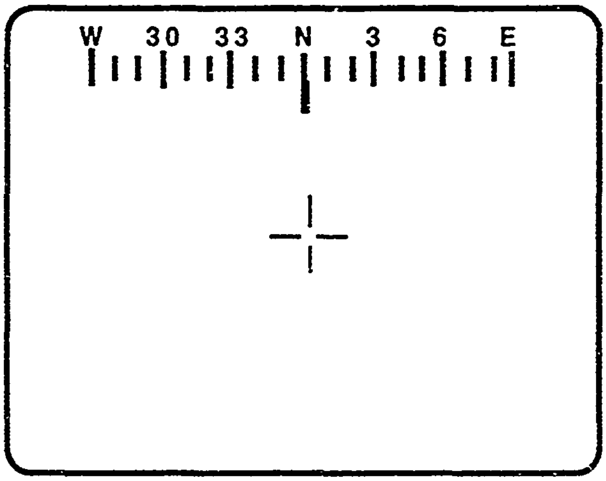
Press spacebar to see demonstration again.

The Heading Scale is shown in green.



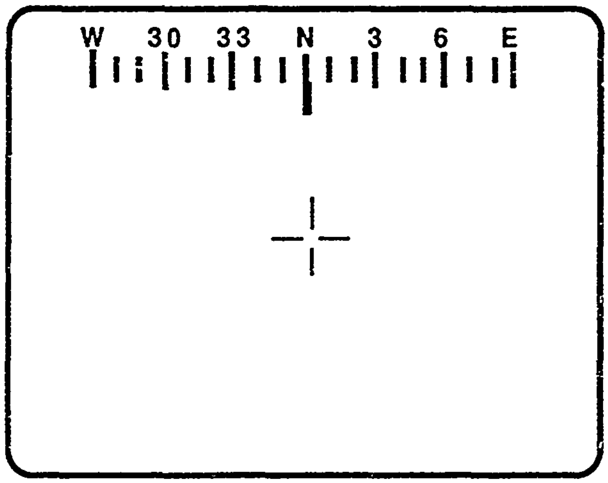
As shown in this display, the helicopter is flying in a heading of 110.

The Fixed Lubber Line is highlighted in green.



The Fixed Lubber Line (representing the nose of the helicopter) also serves as a reference for two other symbols that will be covered in this lesson: the Command Heading and the Alternate Sensor Bearing.

The Heading Scale and Fixed Lubber Line are shown in green.



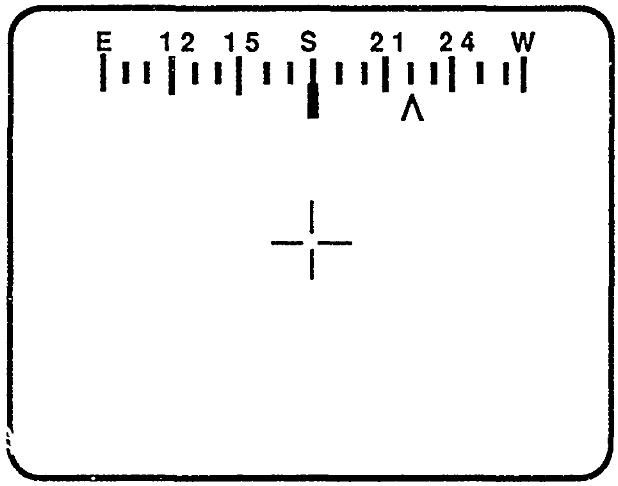
The Heading Scale and the Fixed Lubber Line blank when the Heading and Attitude Reference System (HARS) is invalid or has failed.

Press spacebar to simulate HARS failure.

After 1 second, the Heading Scale and the Fixed Lubber Line disappear from the display.

Press spacebar to see demonstration again.

The Command Heading is highlighted in green.

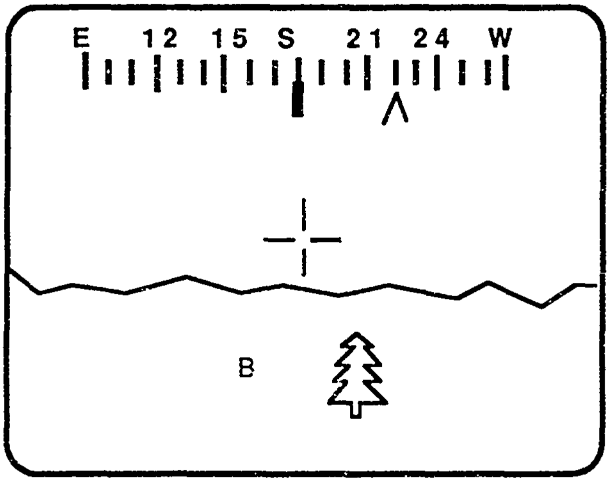


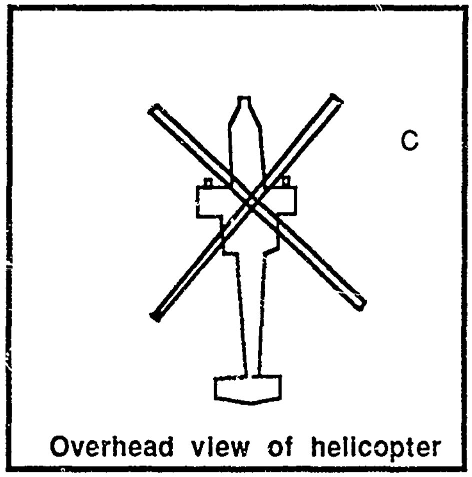
This is the **Command Heading.**

When the pilot selects either the hover, cruise, or transition mode, the Command Heading shows the heading to the next navigation waypoint as designated by the Lightweight Doppler Navigation System (LDNS).

In this display, the heading to the next navigation waypoint is 220.

The Command Heading is highlighted in green.
Letters are not shown.



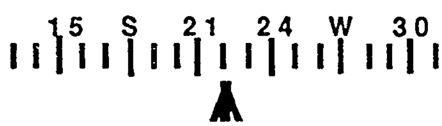


As the pilot turns the helicopter toward the heading of the next navigation waypoint, the Command Heading and the Heading Scale move in the opposite direction that the helicopter is turning.

In this case, the helicopter is turning to the right.

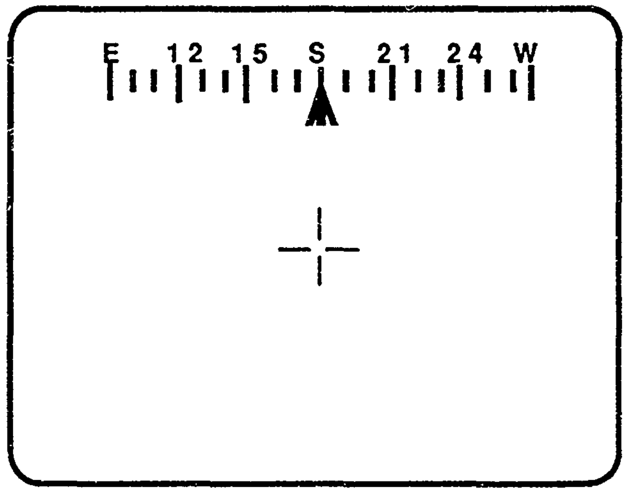
Press spacebar to simulate the helicopter turning to the right.

Command Heading remains at 220 on Heading Scale; Heading Scale moves to the left, in approximately 3 seconds, until 220 and Command Heading are centered over Fixed Lubber Line. Tree and horizon line move to the left until tree is at position "B." At the same time, helicopter pivots until nose is at position "C." Then Heading Scale looks like this:



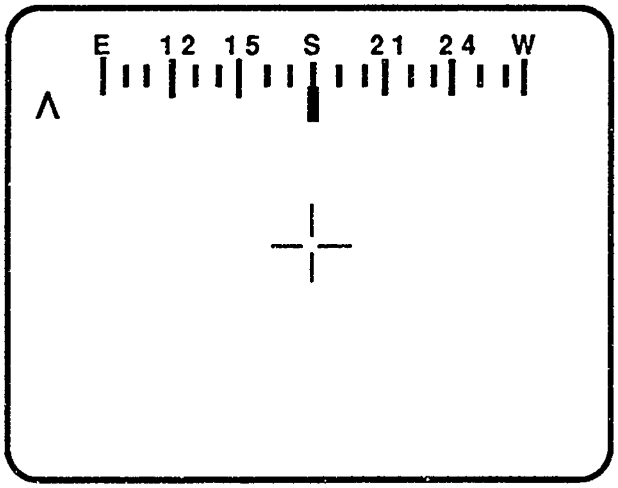
Press spacebar to see demonstration again.

The Command Heading is highlighted in green.



When the helicopter turns to the heading of the next navigation waypoint, the Command Heading is centered on the Fixed Lubber Line.

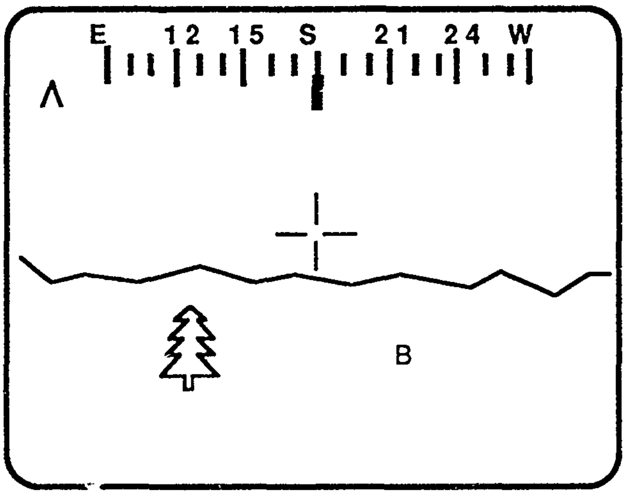
The Command Heading is highlighted in green.

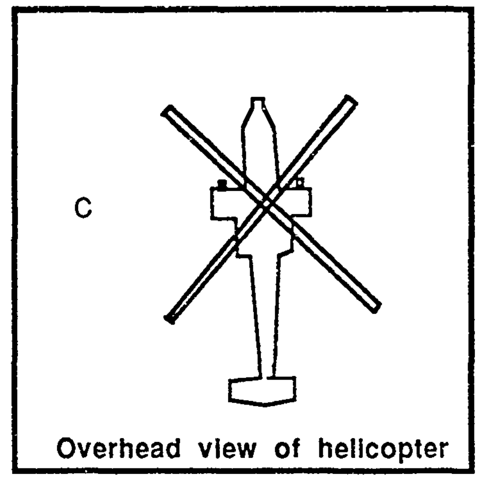


When the next navigation waypoint is more than 90 degrees to the left or right of the helicopter's present heading, the Command Heading is displayed to the left or right of the Heading Scale in the direction of the waypoint.

In this case, the Command Heading is set at 060.

The Command Heading is highlighted in green. Letters are not shown.





Overhead view of helicopter

When the helicopter turns to within 90 degrees of the next navigation waypoint heading, the Command Heading moves with the Heading Scale in the opposite direction that the helicopter is turning.

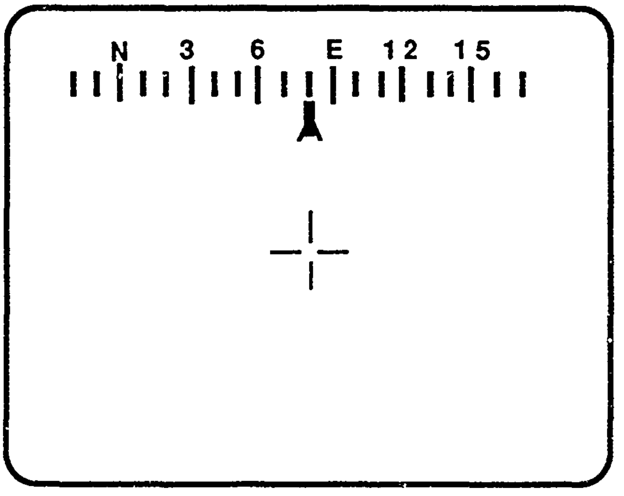
In this case, the helicopter is turning to the left.

Press spacebar to simulate the helicopter turning to the left.

The Heading Scale moves to the right from its present position to 150 degrees. When the Heading Scale reaches 150 degrees, the Command Heading remains at 060 on the Heading Scale and moves with the Heading Scale until the helicopter's heading is 090 (E). Tree and horizon move to the right until tree is at position "B." At the same time, helicopter pivots to the left until nose is at position "C." The entire sequence takes approximately 4 seconds. Then Heading Scale looks like this:

Press spacebar to see demonstration again.

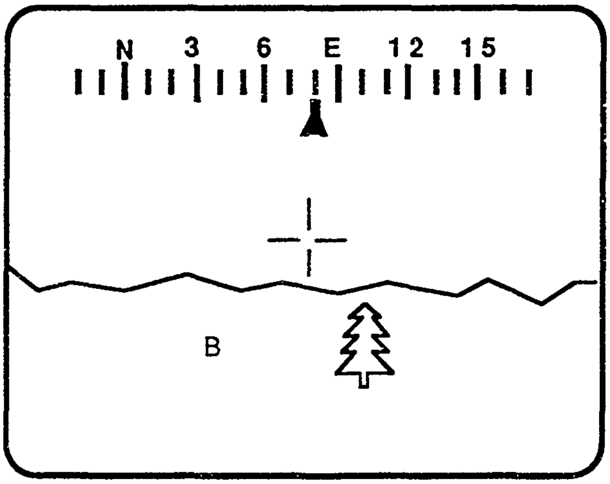
The Command Heading is highlighted in green.

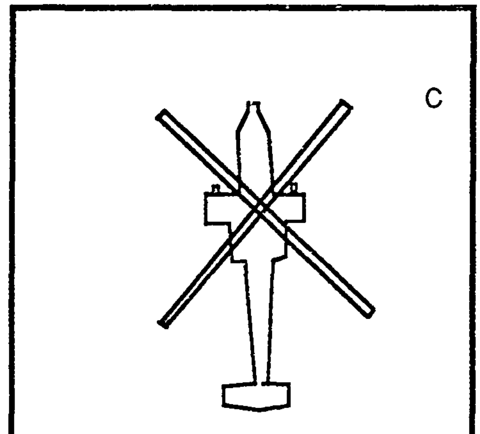


When the bob-up mode is selected, the meaning of the Command Heading changes. The Command Heading now indicates the helicopter's heading by appearing over the Fixed Lubber Line.

As shown in this display, the bob-up mode has just been selected and the helicopter is at a heading of 80 degrees.

The Command Heading is highlighted in green. Letters are not shown.





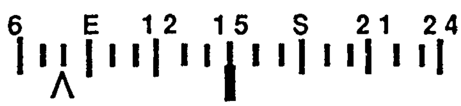
Overhead view of helicopter

As the pilot turns the helicopter away from the heading at which the bob-up mode was selected, the Command Heading, along with the Heading Scale, moves in the opposite direction that the helicopter is turning.

In this case, the helicopter is turning to the right.

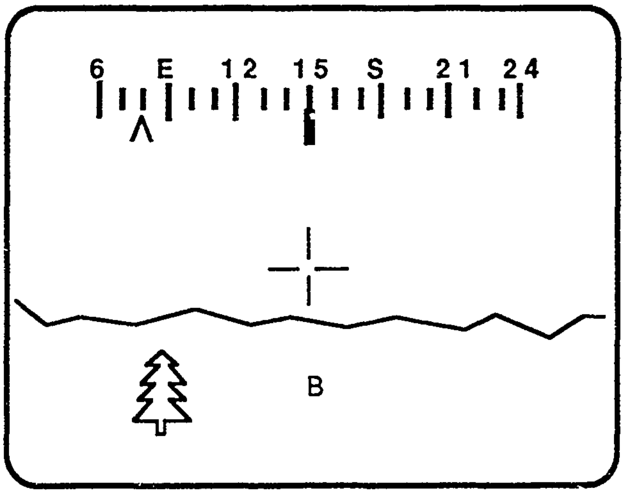
Press spacebar to simulate the helicopter turning to the right.

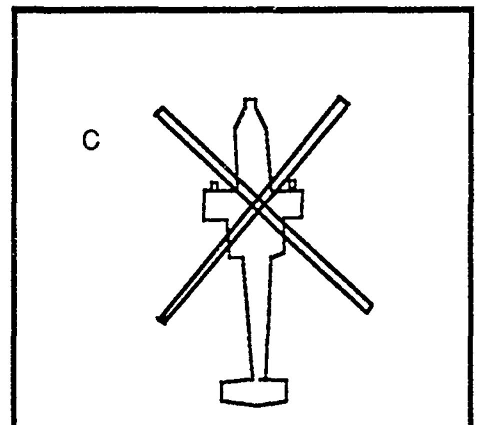
Command Heading remains at 080 on the Heading Scale. Heading Scale and Command Heading move to the left from present position until 150 is centered over the Fixed Lubber Line. Tree and horizon move to the left until tree is at position "B." At the same time, helicopter pivots right until nose is at position "C." The sequence takes approximately 5 seconds. Then Heading Scale will look like this:



Press spacebar to see demonstration again.

The Command Heading is highlighted in green. Letters are not shown.





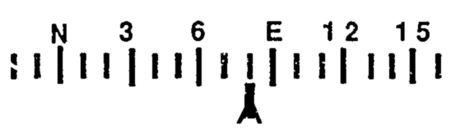
Overhead view of helicopter

To return to the heading at which the bob-up mode was initiated, the pilot turns the helicopter toward the Command Heading until the Command Heading is aligned with the Fixed Lubber Line.

In this case, the helicopter is turning to the left.

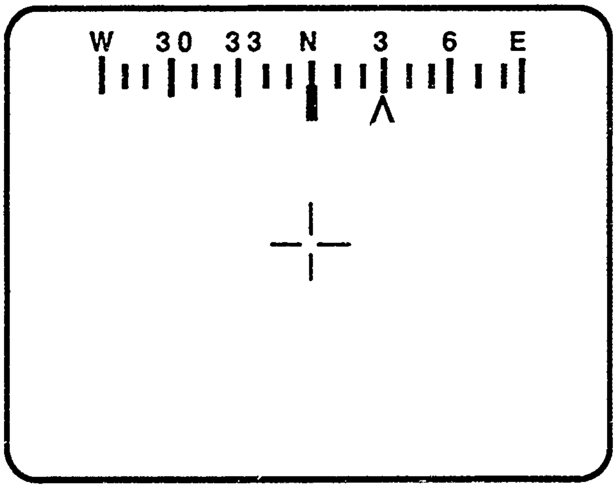
Press spacebar to simulate the helicopter turning to the left.

Command Heading remains at 080. Heading Scale and Command Heading move to the right until 080 is centered over Fixed Lubber Line. Tree and horizon line move to right until tree is at position "B." At the same time, helicopter pivots until nose is at position "C." The sequence takes approximately 5 seconds. Then Heading Scale will look like this:



Press spacebar to see demonstration again.

The Command Heading is highlighted in green.



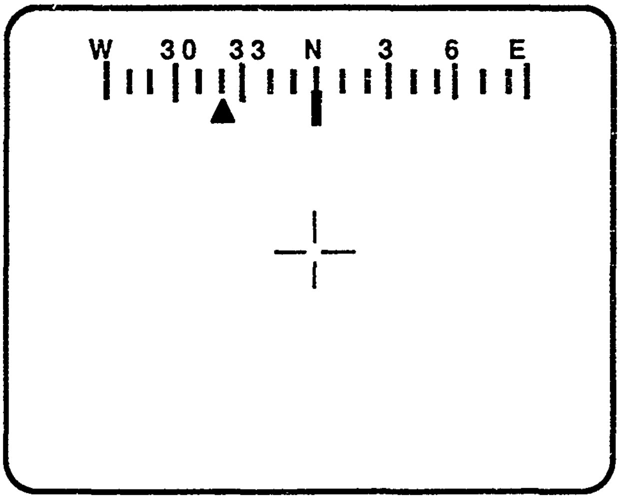
The Command Heading is considered part of the Heading Scale. The Command Heading, along with the Heading Scale and Fixed Lubber Line, blank when the HARS output is invalid or has failed.

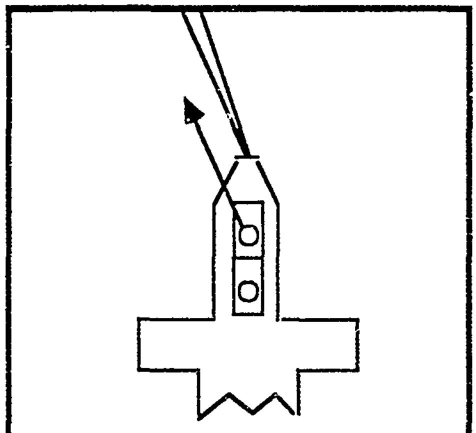
Press spacebar to simulate HARS failure.

After 1 second, Command Heading, Heading Scale, and Fixed Lubber Line disappear from the display.

Press spacebar to see demonstration again.

The Alternate Sensor Bearing is highlighted in green.





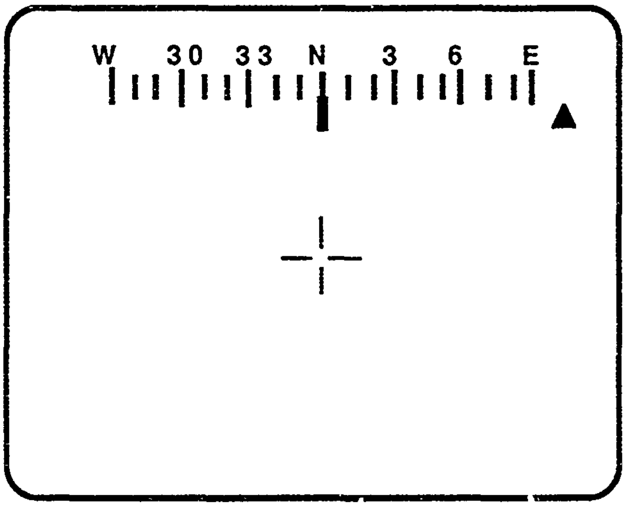
Overhead view of helicopter

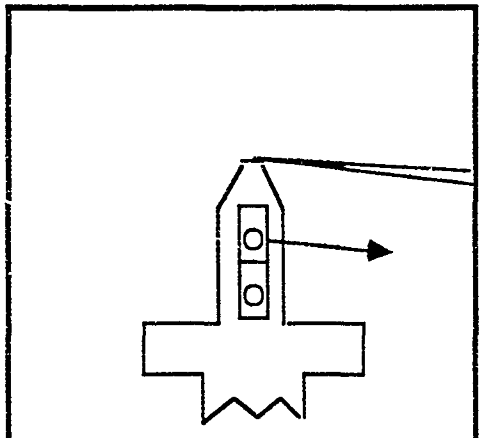
This is the **Alternate Sensor Bearing.**

It indicates the bearing or heading of the CPG's sensor LOS with respect to the heading of the helicopter (which is represented by the Fixed Lubber Line). The CPG's sensor is located in the nose of the helicopter.

As shown in this display, the CPG's sensor LOS is to the left of the helicopter's nose on a heading of 320.

The Alternate Sensor Bearing is highlighted in green. Letters are not shown.



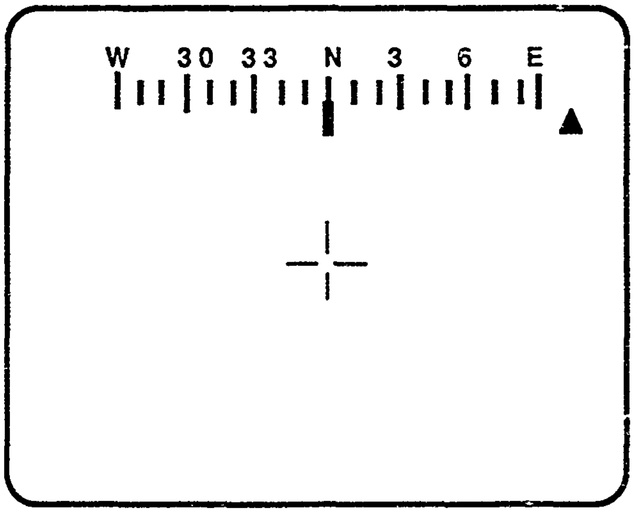


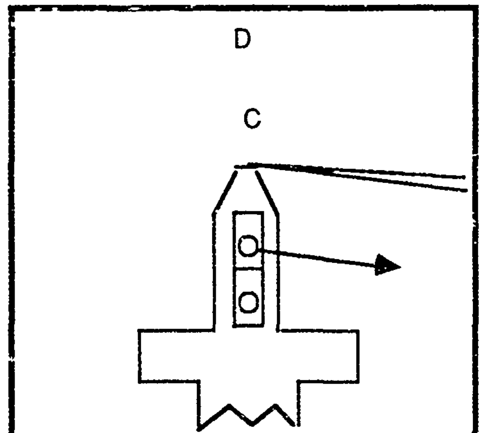
Overhead view of helicopter

When the azimuth of the CPG's sensor LOS is more than 90 degrees to the left or right of the helicopter's present heading, the Alternate Sensor Bearing is displayed to the left or right of the Heading Scale.

In this case, the CPG's sensor LOS is at a heading of 080.

The Alternate Sensor Bearing is highlighted in green. Letters are not shown.





Overhead view of helicopter

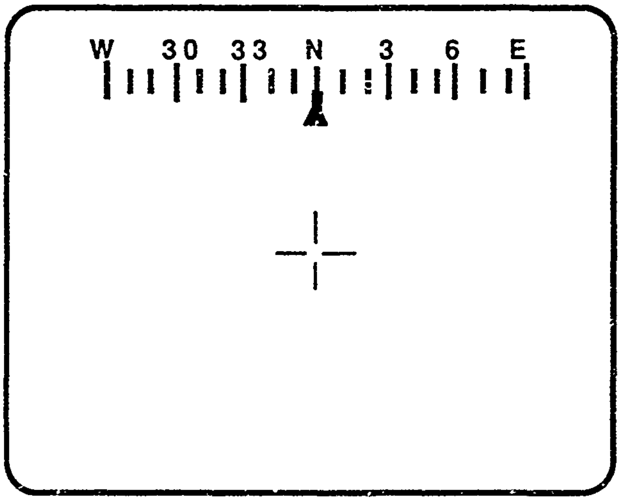
As the CPG's sensor LOS moves to within 90 degrees of the helicopter's heading, the Alternate Sensor Bearing moves toward the Fixed Lubber Line, assuming the heading of the helicopter does not change.

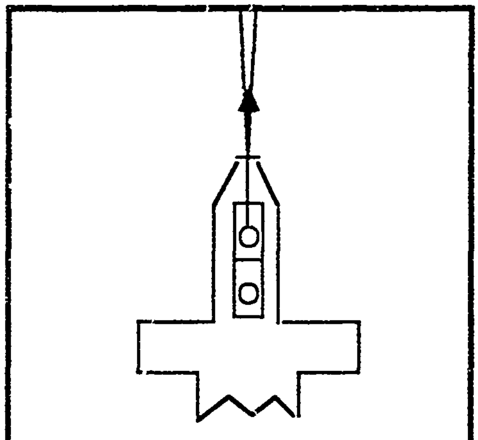
Press spacebar to simulate CPG sensor LOS moving to the left.

The Heading Scale remains stationary. The Alternate Sensor Bearing moves left along the Heading Scale from its present position until it is centered on the Fixed Lubber Line. At the same time, CPG's sensor LOS and viewing direction in diagram on right moves from present position to positions "C" and "D," respectively. The sequence takes approximately 2 seconds.

Press spacebar to see demonstration again.

The Alternate Sensor Bearing is highlighted in green.

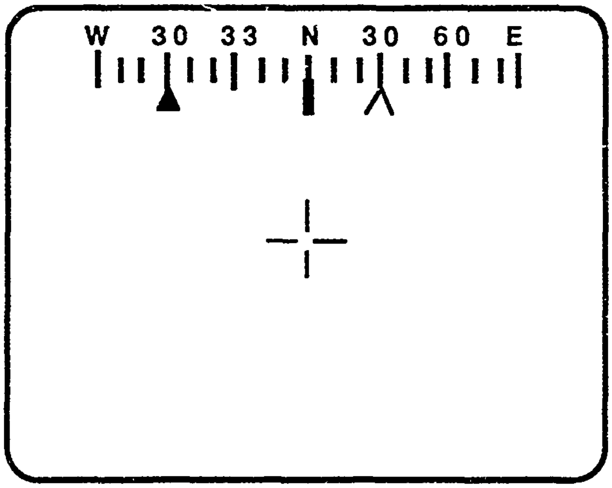




Overhead view of helicopter

As shown in this display, the CPG's sensor LOS is pointed straight ahead on a heading of 360.

The Alternate Sensor Bearing is highlighted in green.



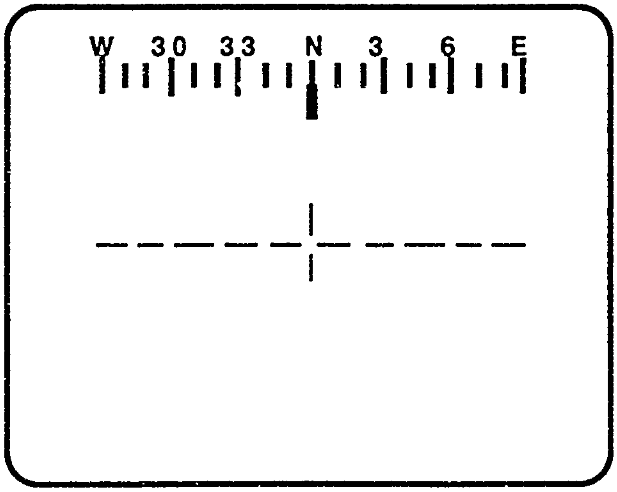
The Alternate Sensor Bearing is considered part of the Heading Scale. The Alternate Sensor Bearing, along with the Heading Scale, Fixed Lubber Line, and the Command Heading blank when the HARS output is invalid or has failed.

Press spacebar to simulate HARS failure.

After 1 second, Alternate Sensor Bearing, Heading Scale, Fixed Lubber Line, and Command Heading disappear from the display.

Press spacebar to see demonstration again.

The Horizon Line is highlighted in green.

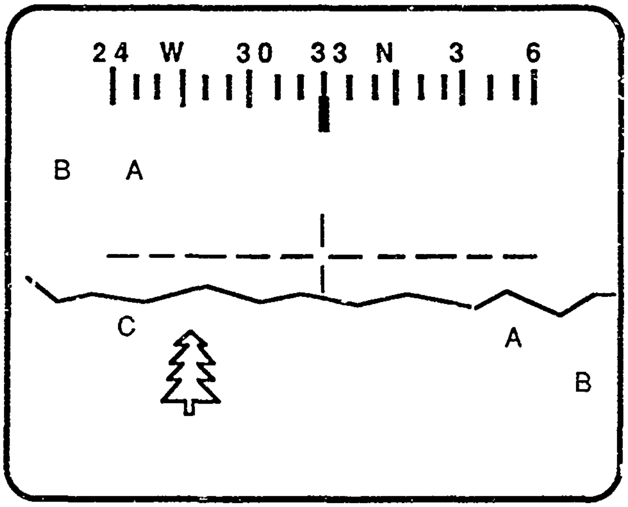


This is the **Horizon Line.**

It shows the pitch and roll attitude of the helicopter with respect to the LOS Reticle (which represents the nose and wings of the helicopter).

The Horizon Line is shown only in the <u>cruise</u> and <u>transition</u> modes of flight.

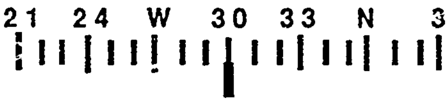
The Horizon Line is highlighted in green. Letters are not shown.



As the helicopter turns to the left, the Heading Scale moves to the right.

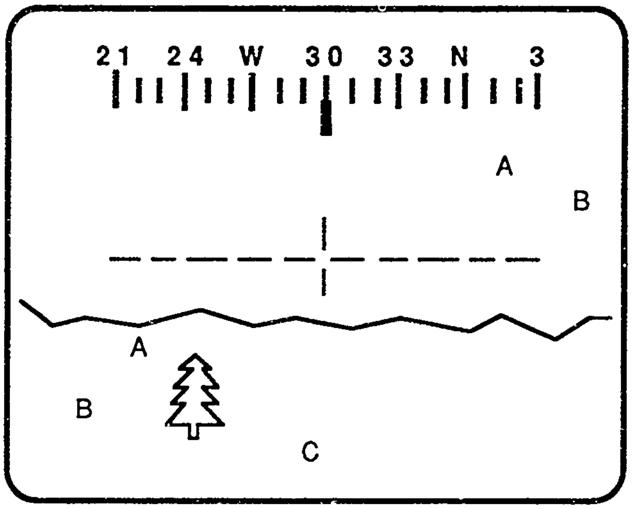
Press spacebar to simulate helicopter turning to the left.

Horizon Line, horizon, and tree move from present positions to positions "A," "B," and "C," respectively in about 1 second. Heading Scale starts moving about .5 second after Horizon Line, horizon, and tree start moving, and moves to the right from 330 to 300 in about 4 seconds. Horizon Line, horizon, and tree start moving back to original positions about .5 second before Heading Scale stops. Horizon Line, horizon, tree, and Heading Scale end movement at the same time. Then Heading Scale looks like this:



Press spacebar to see demonstration again.

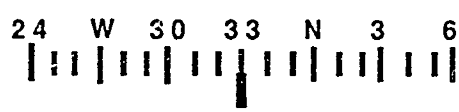
The Horizon Line is highlighted in green. Letters are not shown.



As the helicopter turns to the right, the Heading Scale moves to the left.

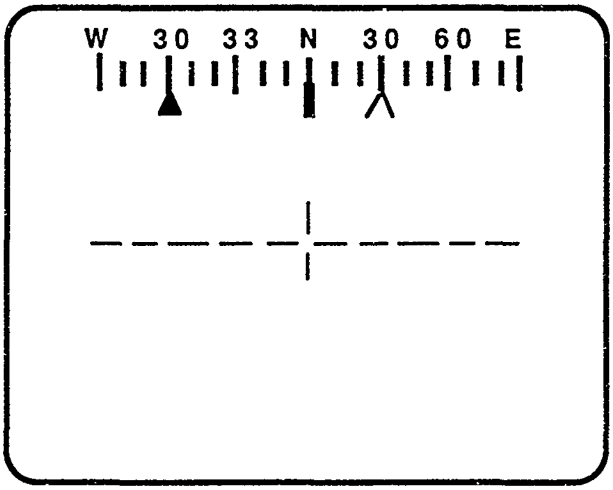
Press spacebar to simulate helicopter turning to the right.

Horizon Line, horizon, and tree move from present positions to positions "A," "B," and "C," respectively in about 1 second. Heading Scale starts moving about .5 second after Horizon Line, horizon, and tree start moving, and moves to the left from 300 to 330 in about 4 seconds. Horizon Line, horizon, and tree start moving back to original positions about .5 second before Heading Scale stops. Horizon Line, horizon, tree and Heading Scale end movement at the same time. Then Heading Scale looks like this:



Press spacebar to see demonstration again.

The Horizon Line is highlighted in green.



The Horizon Line is driven by the HARS. The Horizon Line, along with the Heading Scale, the Fixed Lubber Line, the Alternate Sensor Bearing, and the Command Heading blank if the HARS fails.

Press spacebar to simulate HARS failure.

After 1 second, Horizon Line, Heading Scale, Fixed Lubber Line, Alternate Sensor Bearing, and Command Heading disappear from the display.

Press spacebar to see demonstration again.

You have now completed the lesson on Heading/Navigation Symbols.

Please select what you would like to do now:

- Take the Quiz
- Return to the Main Menu

Symbology Tutor Quiz - Lesson 3: Heading/Navigation Symbols

This quiz tests how much you learned about the Heading/Navigation Symbols presented in Lesson 3. The quiz consists of 21 multiple choice questions. Each answer has a small box associated with it. You will see a cross-shaped pointer just below the question and above the answer boxes. Use the arrow keys on the numeric keypad to move the pointer to the box next to your answer, then press ENTER to confirm your answer. You must answer each question correctly one time before you may leave the quiz.

Press ENTER to begin the quiz.

No Display Shown

The Heading Scale shows approximately how many degrees of magnetic heading at one time:

1) 60 degrees
2) 90 degrees
3) 20 degrees
4) 180 degrees

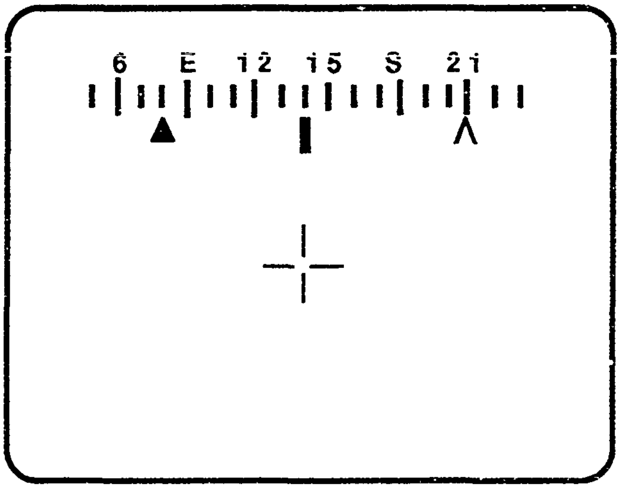
Correct answer = 4. If response = 1, 2, or 3, go to III-T2.

III-Q2

No
Display
Shown

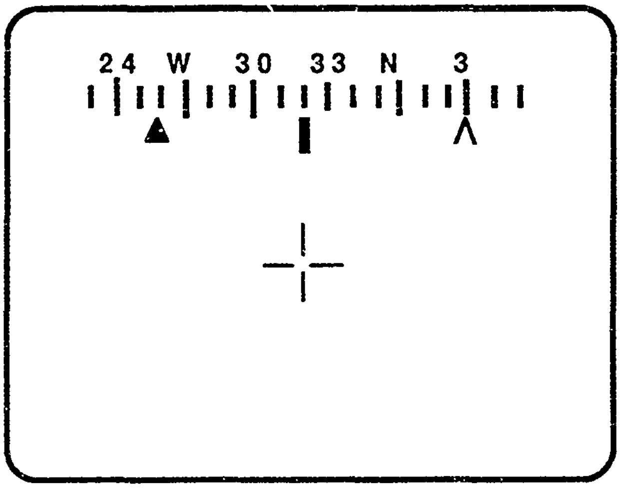
The Fixed Lubber Line represents:
1) the nose of the aircraft
2) the heading of the pilot's sensor LOS
3) the heading of the CPG's sensor LOS
4) the heading to the next navigation waypoint

Correct answer = 1. If response = 2 or 3, go to III-T1; if 4, go to III-T1, III-T8.



As shown in this display, the heading of the helicopter is:
1) 080
2) 140
3) 180
4) 210

Correct answer = 2. If response = 1, 3, or 4, go to III-T2, III-T5.



If the helicopter turns to the left:
1) The Fixed Lubber Line remains stationary and the Heading Scale moves to the left
2) The Fixed Lubber Line remains stationary and the Heading Scale moves to the right
3) The Heading Scale remains stationary and the Fixed Lubber Line moves to the left
4) The Heading Scale remains stationary and the Fixed Lubber Line moves to the right

Correct answer = 2. If response = 1, 3, or 4, go to III-T1, III-T3.

**No
Display
Shown**

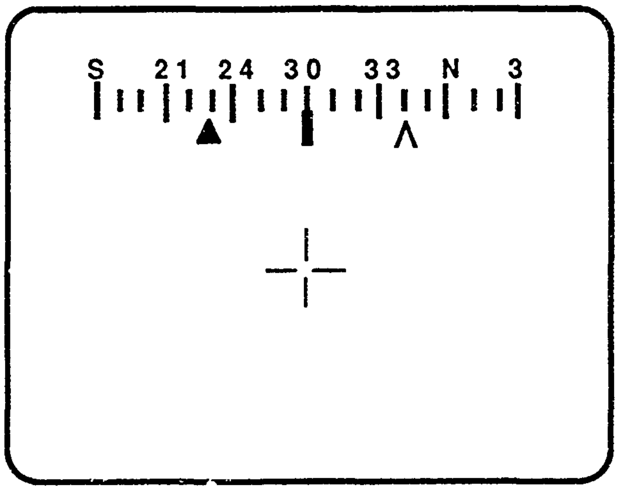
The Heading Scale and the Fixed Lubber Line blank when:
1) the HARS fails
2) the ADSS fails
3) the LDNS fails
4) the Radar Altimeter fails

Correct answer = 1. If response = 2, 3, or 4, go to III-T7.

No Display Shown

When the pilot selects the cruise mode, the Command Heading shows:
1) the helicopter's present heading
2) the heading of the CPG's sensor LOS
3) the helicopter's heading when the bob-up mode was selected
4) the heading to the next navigation waypoint

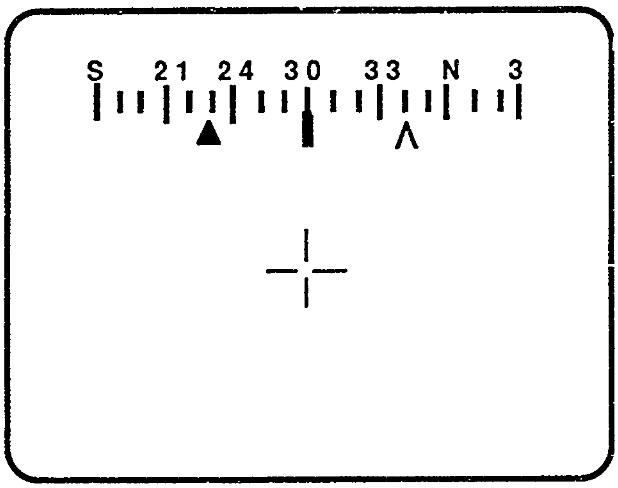
Correct answer = 4. If response = 1, go to III-T8, III-T1; if 2, go to III-T8, III-T17; if 3, go to III-T8, III-T13.



As shown in this display, if the pilot selects the transition mode, the heading to the next navigation waypoint is:

1) 220
2) 300
3) 310
4) 340

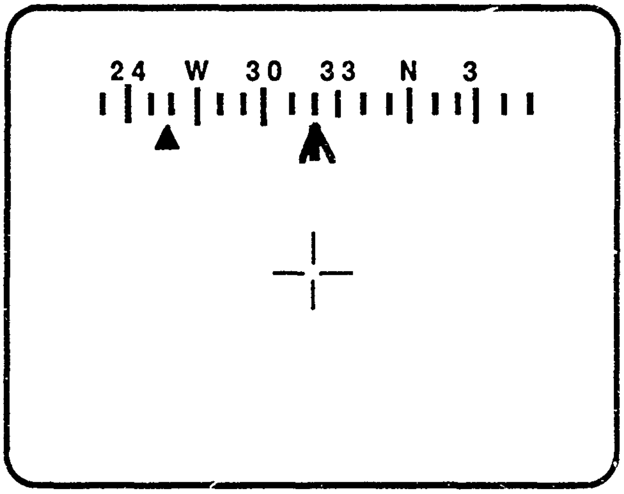
Correct answer = 4. If response = 1, go to III-T8, III-T17; if 2, go to III-T8, III-T1; if 3, go to III-T8.



As shown in this display, when the helicopter turns toward the heading of the next navigation waypoint:

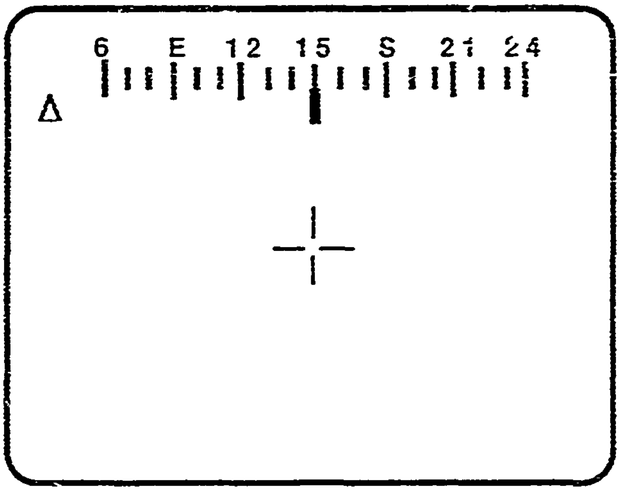
1) the Command Heading does not move, the Heading Scale moves to the left
2) the Command Heading does not move, the Heading Scale moves to the right
3) the Command Heading and the Heading Scale move together to the left
4) the Command Heading and the Heading Scale move together to the right

Correct answer = 3. If respon:e = 1 or 2, go to III-T9; if 4, go to III-T9, 1II-T17.



As shown in this display, if the pilot selects the cruise mode:
1) the helicopter's heading is identical to the heading to the next navigation waypoint
2) the helicopter's heading is identical to the heading at which the bob-up mode was selected
3) the helicopter's heading is identical to the CPG's sensor LOS
4) the heading to the next navigational waypoint is 260 degrees

Correct answer = 1. If response = 2, go to III-T10, III-T13; if 3 or 4, go to III-T10, III-T17.



If the pilot selects the cruise mode, the symbology in this display shows that:

1) the Alternate Sensor Bearing is more than 90 degrees to the left of the helicopter's nose
1) the Alternate Sensor Bearing is more than 90 degrees to the right of the helicopter's nose
3) the Command Heading is more than 90 degrees to the left of the helicopter's nose
4) the Command Heading is more than 90 degrees to the right of the helicopter's nose

Correct answer = 3. If response = 1 or 2, go to III-T11, III-T17; if 4, go to III-T11.

III-Q11

No
Display
Shown

When the helicopter turns to within 90 degrees of the next navigation waypoint heading, the Command Heading:

1) moves with the Heading Scale in the same direction that the helicopter is turning
2) moves with the Heading Scale in the opposite direction that the helicopter is turning
3) remains fixed at the left side of the Heading Scale
4) flashes on and off until the helicopter is within 90 degrees of the next navigation waypoint

Correct answer = 2. If response = 1, 3, or 4, go to III-T12.

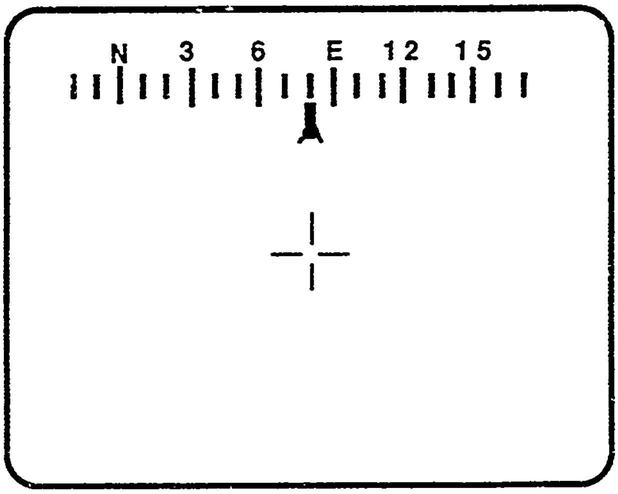
III-Q12

No
Display
Shown

When the bob-up mode is selected, the Command Heading indicates:

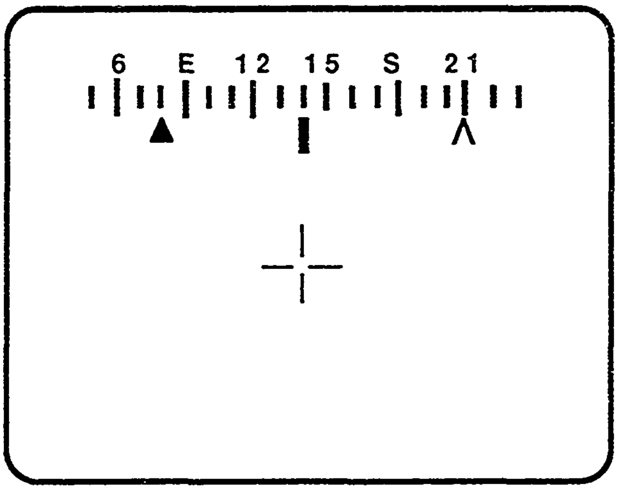
1) the pilot's sensor LOS at the time the bob-up mode was selected
2) the CPG's sensor LOS at the time the bob-up mode was selected
3) the heading to the next navigation waypoint at the time the bob-up mode was selected
4) the helicopter's heading at the time the bob-up mode was selected

Correct answer = 4. If response = 1, go to III-T13; if 2, go to III-T13, III-T17; if 3, go to III-T13, III-T8.



As shown in this display, if the pilot selects the bob-up mode and the helicopter turns to the right, the Command Heading:
1) moves to the left
2) moves to the right
3) remains at its present position
4) disappears from the display

Correct answer = 1. If response = 2, 3, or 4, go to III-T14.



As shown in this display, to return to the heading at which the bob-up mode was initiated, the pilot should turn the helicopter to what heading?

1) 080
2) 140
3) 210
4) 240

Correct answer = 3. If response = 1, go to III-T15, III-T17; if 2, go to III-T15, III-T1; if 4, go to III-T15.

III-Q15

No
Display
Shown

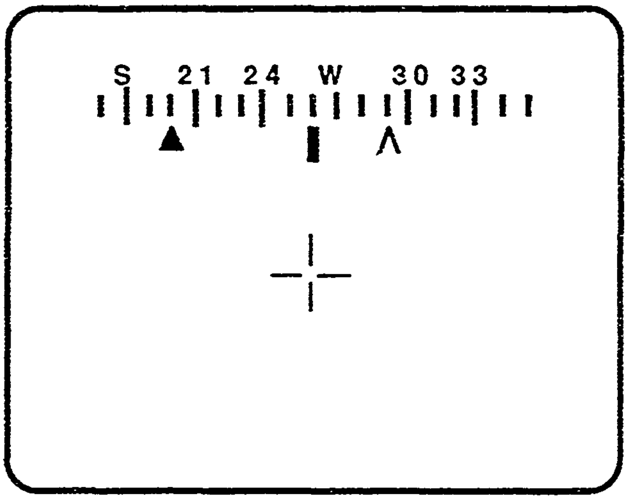
The Command Heading blanks when:
1) the LDNS fails
2) the Radar Altimeter fails
3) the HARS fails
4) the ADSS fails

Correct answer = 3. If response = 1, 2, or 4, go to III-T16.

**No
Display
Shown**

The Alternate Sensor Bearing indicates:
1) the heading to the next navigation waypoint
2) the helicopter's present heading
3) the CPG's sensor LOS
4) the pilot's sensor LOS

Correct answer = 3. If response = 1 or 4, go to III-T17; if 2, go to III-T17, III-T8.



As shown in this display, the CPG's sensor LOS is:
1) 160
2) 200
3) 260
4) 290

Correct answer = 2. If response = 1, go to III-T17; if 3, go to III-T17, III-T1; if 4, go to III-T17, III-T8.

No
Display
Shown

If the CPG's sensor LOS is more than 90 degrees to the left or right of the helicopter's heading, the Alternate Sensor Bearing:

1) flashes intermittently
2) disappears from the display
3) appears to the left or right edge of the Heading Scale
4) appears in the middle of the Heading Scale

Correct answer = 3. If response = 1 or 4, go to III-T18; if 2, go to III-T18, III-T21.

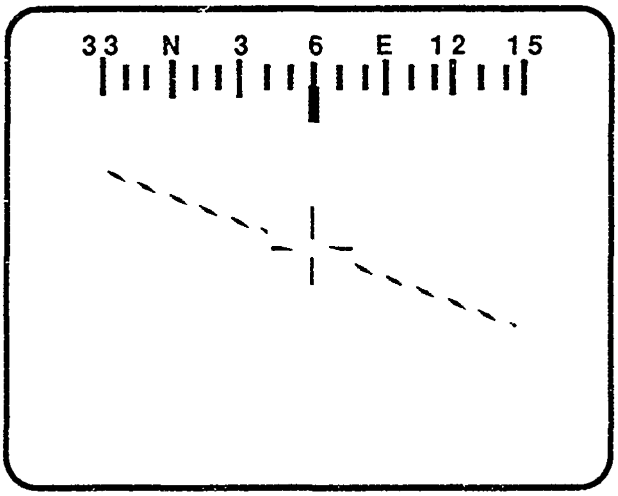
III-Q19

No
Display
Shown

The Alternate Sensor Bearing blanks when:
1) the HARS fails
2) the LDNS fails
3) the ADSS fails
4) the Radar Altimeter fails

Correct answer = 1. If response = 2, 3, or 4, go to III-T21.

III-Q20



According to the symbology shown in this display:

1) The Fixed Lubber Line remains stationary and the Heading Scale moves to the left
2) The Fixed Lubber Line remains stationary and the Heading Scale moves to the right
3) The Heading Scale remains stationary and the Fixed Lubber Line moves to the left
4) The Heading Scale remains stationary and the Fixed Lubber Line moves to the right

Correct answer = 2. If response = 1, 3, or 4, go to III-T23.

**No
Display
Shown**

The Horizon Line blanks when:
1) the ADSS fails
2) the Radar Altimeter fails
3) the LDNS fails
4) the HARS fails

Correct answer = 4. If response = 1, 2, or 3, go to III-T25.

APPENDIX D

SYMBOLOGY TUTOR STORYBOARDS FOR LESSON 4: CENTRAL/PERIPHERAL CUEING/REFERENCE SYMBOLS

Lesson 4a

Central Cueing/Reference Symbols

The purpose of Lesson 4 is to teach you to identify and understand the meaning of symbols in the Flight Symbology set that give the pilot cueing and reference information. Lesson 4 is divided into two parts: Lesson 4a covers cueing/reference symbols that are located in the central part of the display; Lesson 4b covers cueing/reference symbols that are located in the lower part of the display.

You are now in Lesson 4a. The symbols covered in Lesson 4a are:

- The Head Tracker
- The Cueing Dots
- The Cued LOS Reticle

The symbols that are covered in Lesson 4b are:

- The Field of Regard Box
- The Field of View Box
- The Cued LOS Dot

You can go through Lesson 4a and 4b in any order; however, it is recommended that you go through Lesson 4a before proceeding to Lesson 4b.

The word "green" is shown in the color green; the word "blue" is shown in the color blue.

This lesson is divided into two parts: A Tutorial and a Quiz.

Tutorial

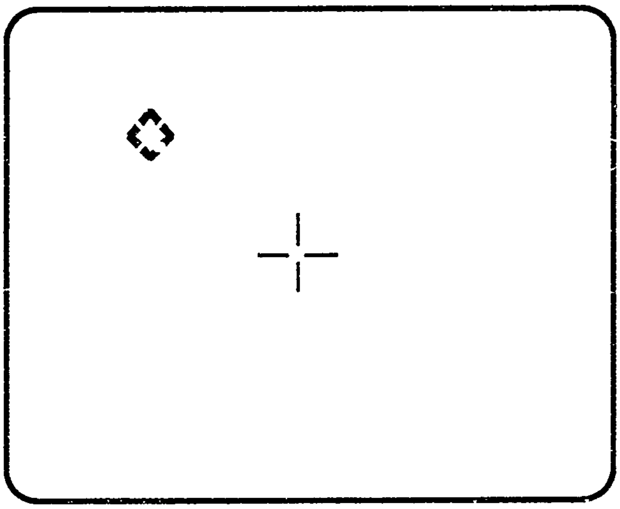
In the first part, a facsimile of an AH-64 visual display showing one symbol or a small group of symbols is shown on the top part of the screen. The symbol or symbols of interest are highlighted in **green** and described briefly below the display. Supplementary material that does not appear on the AH-64 display is shown in **blue**. In some cases, you will have the opportunity to see a brief demonstration of how the symbol or symbols move in the display.

The Line of Sight (LOS) Reticle (covered in Lesson 1) is included on each display in the tutorial to provide a general frame of reference.

Quiz

The second part of this lesson consists of a quiz covering the material you have just learned. If you answer a question incorrectly, you will briefly review the material covered in that question before proceeding with the quiz. After you have completed the quiz, you will have the opportunity to review the lesson again, go on to another lesson, or quit the program.

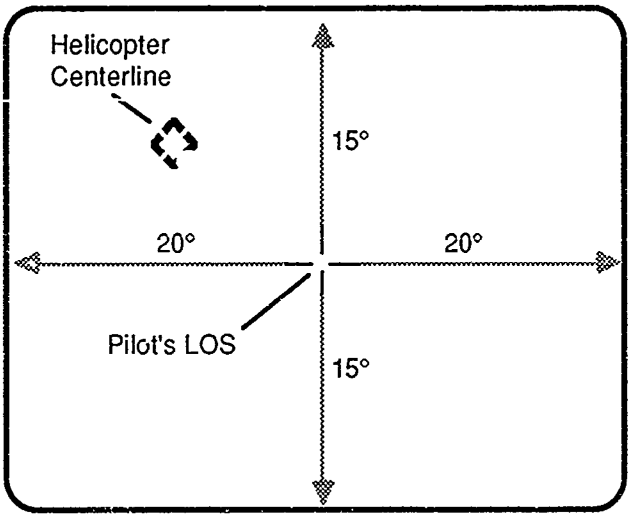
The Head Tracker is highlighted in green.



This is the **Head Tracker.**

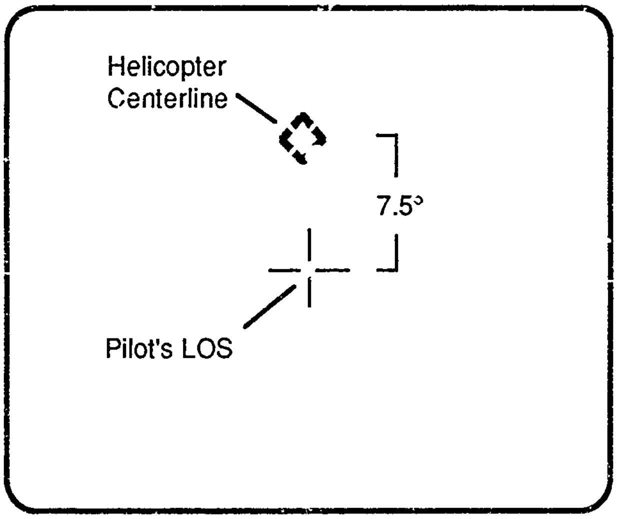
It indicates the location of the helicopter centerline in relation to the pilot's LOS (which is represented by the LOS Reticle).

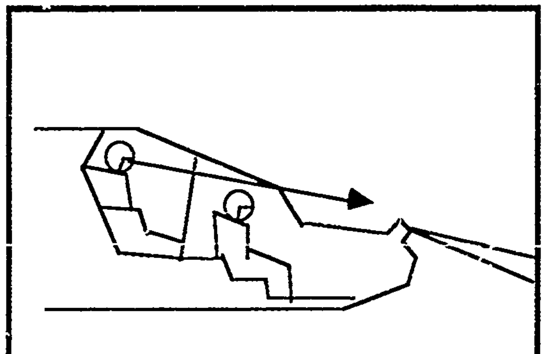
The Head Tracker is highlighted in green. Text, dotted lines, numbers, and arrows in display are shown in blue.



The Head Tracker is displayed when the pilot's LOS is within ±20 degrees azimuth and ±15 degrees elevation of the aircraft centerline.

The Head Tracker is highlighted in green. Text, lines, and numbers are shown in blue.

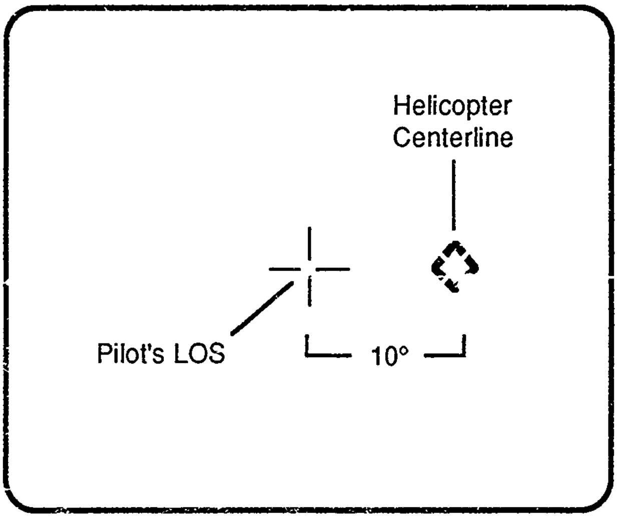


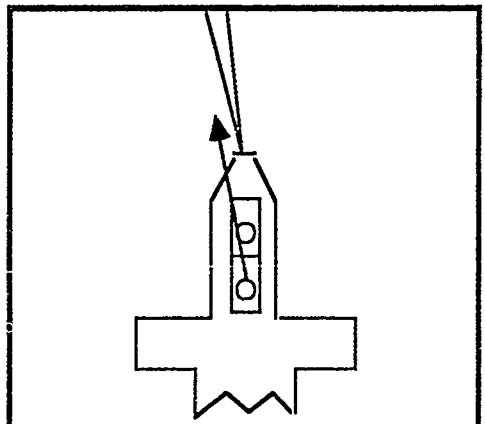


Side view of helicopter

As shown in this display and in the diagram on the right, the pilot's LOS is approximately 7.5 degrees below the helicopter centerline.

The Head Tracker is highlighted in green. Text, lines, and numbers are shown in blue.

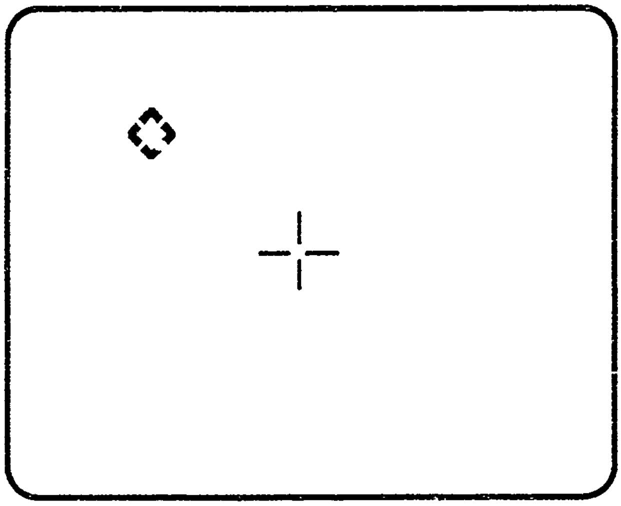




Overhead view of helicopter

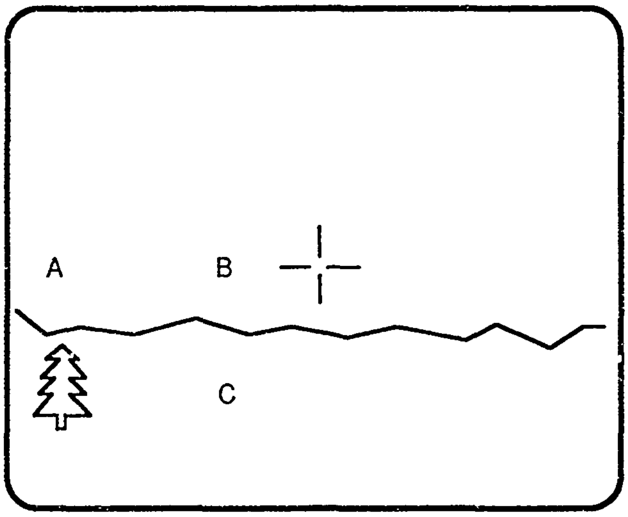
As shown in this display and in the diagram on the right, the pilot's LOS is approximately 10 degrees to the left of the helicopter centerline.

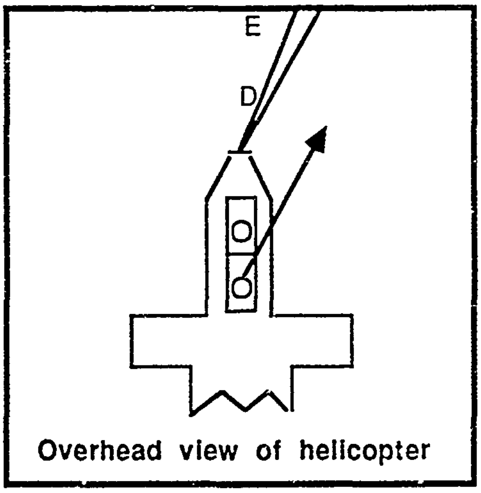
The Head Tracker is highlighted in green.



As shown in this display, the pilot's LOS is approximately 7.5 degrees below and 10 degrees to the right of the helicopter centerline.

Nothing is highlighted in green. Letters are not shown.





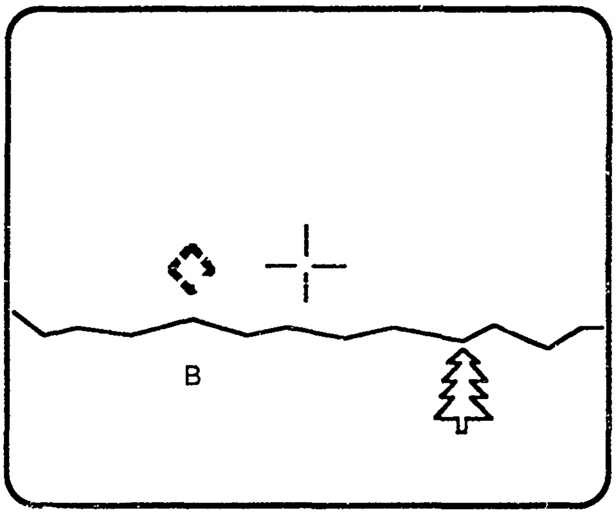
When the pilot moves his LOS within 20 degrees (azimuth) or 15 degrees (elevation) of the helicopter centerline, the Head Tracker moves onto the display.

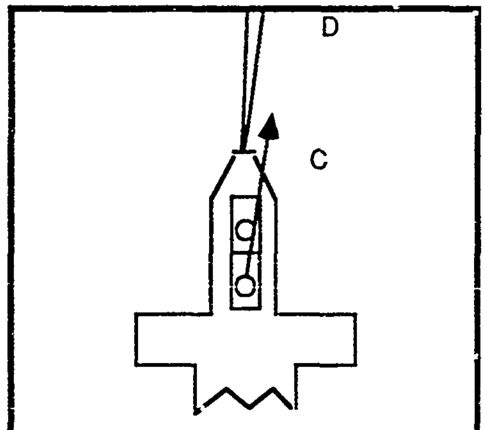
Press spacebar to simulate pilot moving his LOS from right to left to within 20 degrees azimuth of the helicopter centerline.

After 1-second delay, Head Tracker appears at position "A" and moves to position "B" in about 1 second. At the same time, tree and horizon move to the right until tree is at position "C"; pilot's viewing direction and sensor LOS in diagram move left from present positions to positions "D" and "E", respectively.

Press spacebar to see demonstration again.

The Head Tracker is highlighted in green. Letters are not shown.





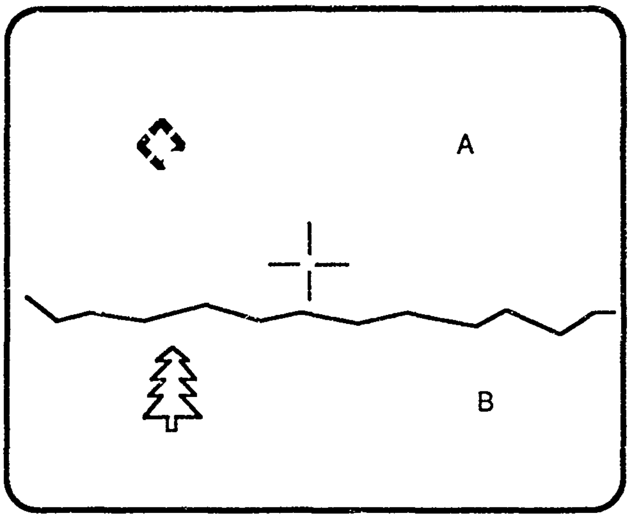
Overhead view of helicopter

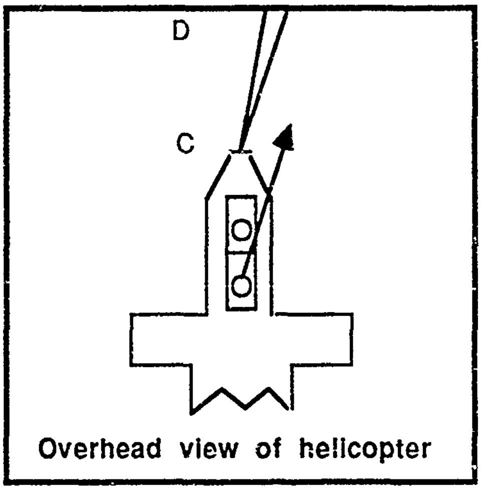
When the pilot moves his LOS more than 20 degrees azimuth or 15 degrees elevation away from the helicopter centerline, the Head Tracker moves off the display.

Press spacebar to simulate pilot moving his LOS 40 degrees to the right.

After 1 second, Head Tracker moves from present position to the left until it disappears from the display. At the same time, tree and horizon move to the left until tree is at position "B"; pilot's sensor LOS and viewing direction in diagram move to the right from present positions to positions "C" and "D", respectively.

The Head Tracker is highlighted in green. Letters are not shown.





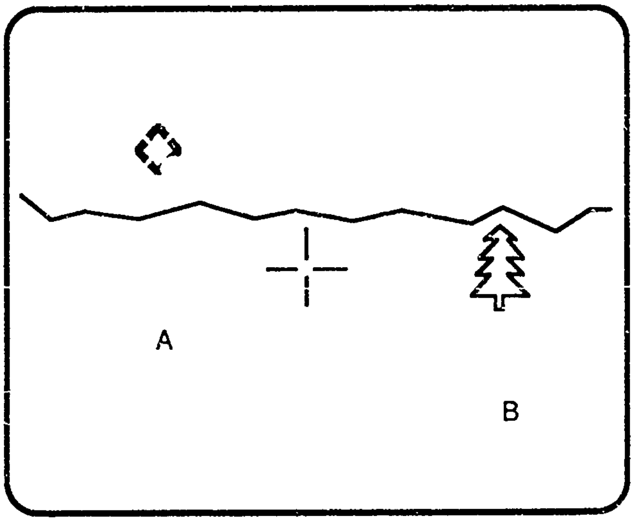
The Head Tracker moves in the opposite direction that the pilot moves his LOS. For example, if the pilot moves his LOS to the left, the Head Tracker moves to the right, while the LOS Reticle remains stationary.

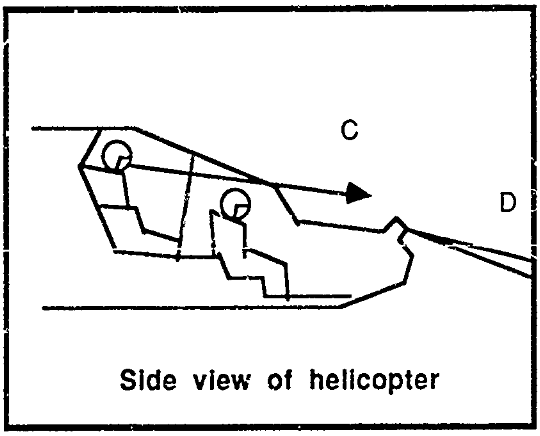
Press spacebar to simulate pilot moving his LOS from right to left.

Head Tracker moves from present position to Position "A". At the same time, horizon and tree move from present position to the right until the tree is at position "B", and pilot's viewing direction and sensor LOS in diagram move from present position to positions "C" and "D", respectively. The sequence takes about 1 second.

Press spacebar to see demonstration again.

The Head Tracker is highlighted in green. Letters are not shown.





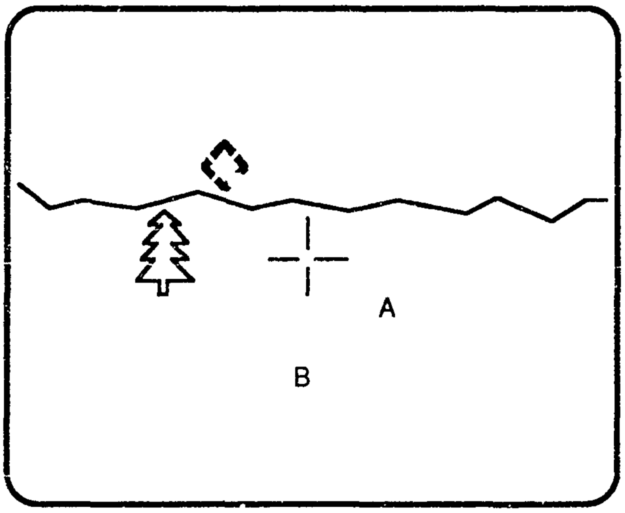
If the pilot moves his LOS upward, the Head Tracker moves downward, while the LOS Reticle remains stationary.

Press spacebar to simulate pilot moving his LOS upward.

Head Tracker moves from present position to Position "A". At the same time, horizon and tree move downward from present position until tree is at position "B", and pilot's viewing direction and sensor LOS in diagram move from present position to positions "C" and "D", respectively. The sequence takes about 1 second.

Press spacebar to see demonstration again.

The Head Tracker is highlighted in green. Letters are not shown.



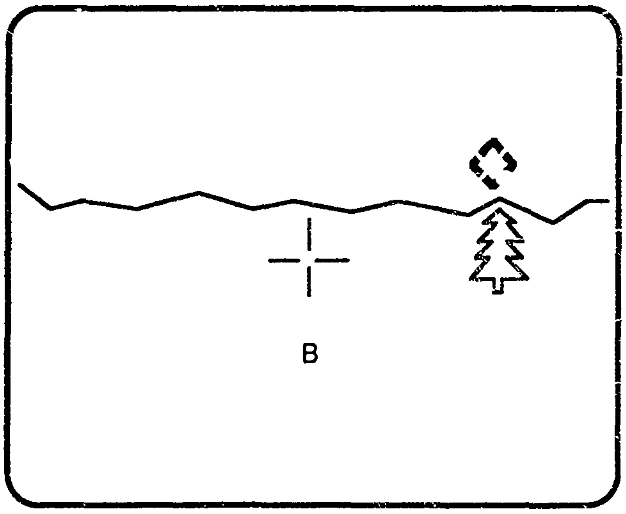
If the pilot moves his LOS upward and to the left, the Head Tracker moves downward and to the right, while the LOS Reticle remains stationary.

Press spacebar to simulate pilot moving his LOS upward and to the left.

Head Tracker moves from present position downward and to the right to Position "A". At the same time, horizon and tree move downward and to the right from present position until tree is at position "B". The sequence takes about 1 second.

Press spacebar to see demonstration again.

The Head Tracker is highlighted in green. Letters are not shown.



As shown in this display, the pilot's LOS is below and to the left of the helicopter centerline.

To have the LOS coincident with the helicopter centerline, the pilot should move his LOS upward and to the right, in the direction of the Head Tracker.

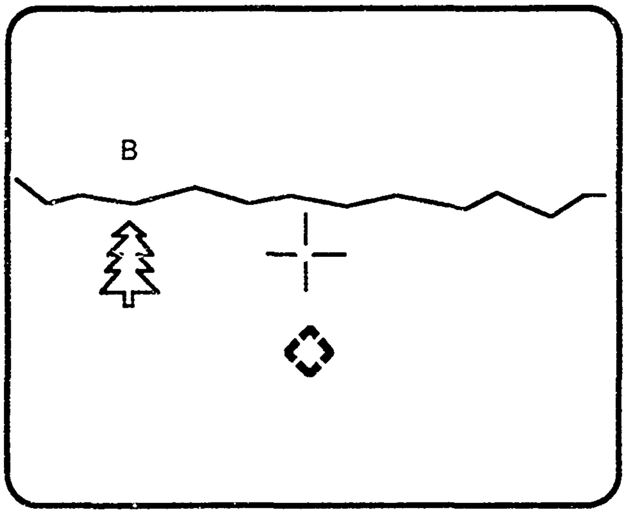
Press spacebar to simulate pilot moving his LOS upward and to the right.

Head Tracker moves downward and to the left until it overlaps the LOS Reticle. At the same time, horizon and tree move downward to the left from present position until tree is at position "B". The sequence takes about 1 second. Then add text:

When the pilot's LOS is coincident with the helicopter centerline, the Head Tracker and the LOS Reticle overlap.

Press spacebar to see demonstration again.

The Head Tracker is highlighted in green. Letter is not shown.



As shown in this display, the pilot is looking directly above the helicopter centerline.

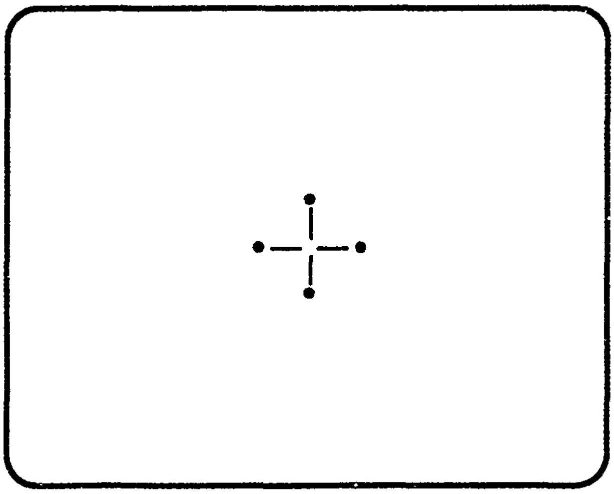
To have his LOS coincident with the helicopter centerline, the pilot should move his LOS downward until the Head Tracker and the LOS Reticle overlap.

Press spacebar to simulate pilot moving his LOS downward.

Head Tracker moves upward until it is centered on the LOS Reticle. At the same time, horizon and tree move upward from present position until tree is at position "B". The sequence takes about 1 second.

Press spacebar to see demonstration again.

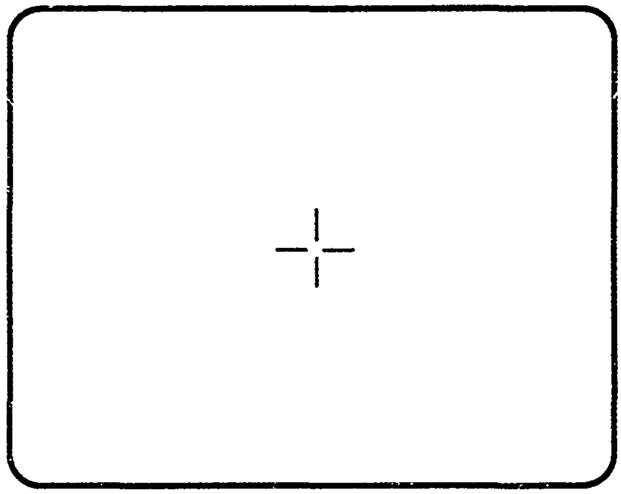
The Cueing Dots are highlighted in green.



These are the **Cueing Dots**.

The Cueing Dots serve two functions:
- to indicate that an IHADDS boresight is required, and
- to indicate cued direction for target acquisition.

Nothing is highlighted in green.



When all four Cueing Dots are flashing, this indicates that an Integrated Helmet and Display Sighting System (IHADSS) boresight is required.

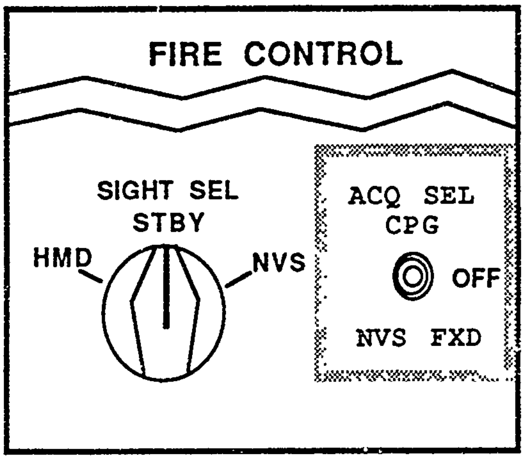
The Cueing Dots remain on the screen and flash until the boresight is accomplished.

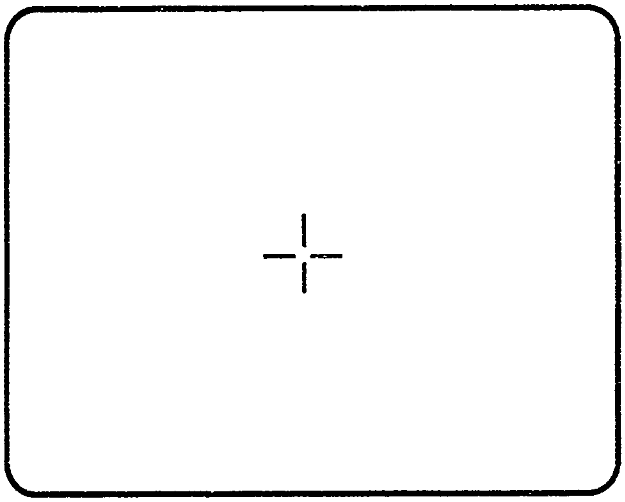
Press spacebar to simulate that an IHADSS boresight is required.

All four Cueing Dots appear and flash at rate of .75 sec on/.25 sec off for 5 seconds.

Press spacebar to see demonstration again.

Nothing is highlighted in green. Left-hand segment of Fire Control Panel is shown on left. Blue box is drawn around ACQ SEL switch which is in the "OFF" position.





One or two Cueing Dots appear at the top, bottom, or sides of the LOS Reticle to indicate the direction the pilot should move his LOS to be coincident with the CPG's LOS when:

- the pilot places the ACQ SEL switch on the Fire Control Panel in the CPG position (up), and
- the CPG's LOS is more than 4 degrees from the pilot's LOS.

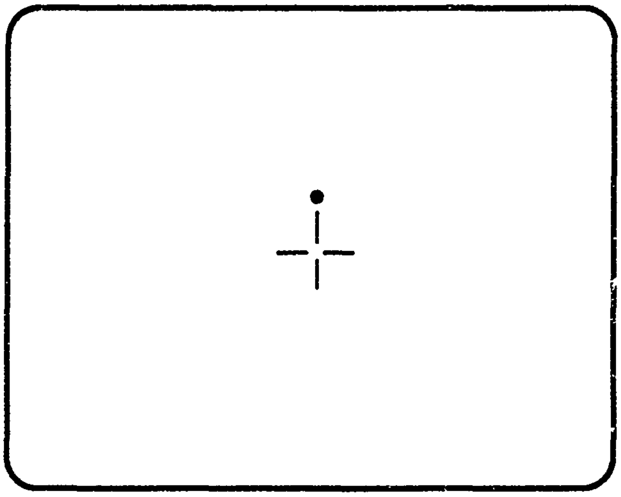
Press spacebar to simulate pilot placing the ACQ SEL switch in the CPG position.

The ACQ SEL switch is shown in the "CPG" position. The right Cueing Dot appears. Then add this text:

In this display, the right Cueing Dot appears to indicate that the pilot should look directly to the right for his LOS to be coincident with the CPG's LOS.

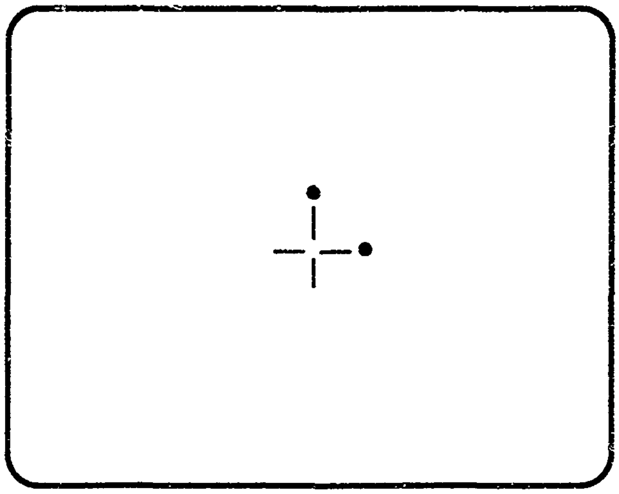
Press spacebar to see demonstration again.

The top Cueing Dot is highlighted in green.



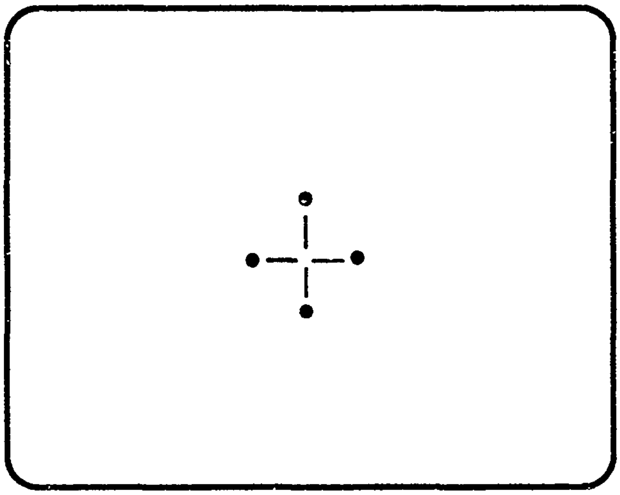
As shown in this display, the pilot needs to look directly upward for his LOS to be coincident with the CFG's LOS.

The top and right Cueing Dots are highlighted in green.



As shown in this display, the pilot needs to move his LOS upward and to the right for his LOS to be coincident with the CPG's LOS.

All four Cueing Dots are highlighted in green. Bottom and left Cueing Dots are flashing at a .75 sec on/.25 sec off rate.

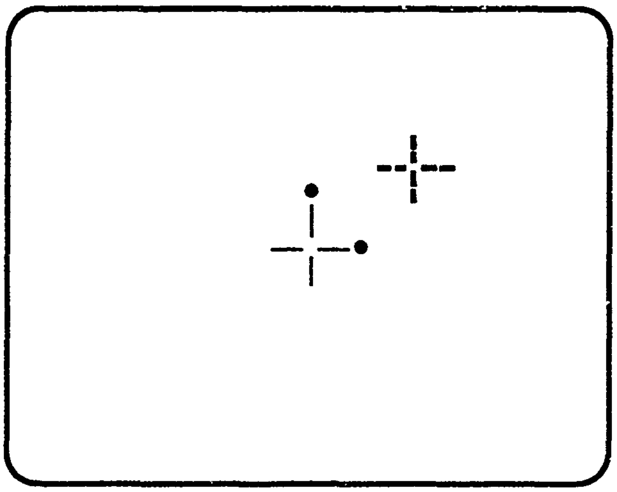


If the pilot selects cueing (places the ACQ SEL switch in the CPG position) and a boresight is required, the cueing dot(s) providing the cueing remain on in the steady state, while the remaining dots flash.

The Cueing Dots in this display indicate that:

- the pilot should move his LOS upward and to the right to be coincident with the CPG's LOS, and
- a boresight is required.

The Cued LOS Reticle is highlighted in green.

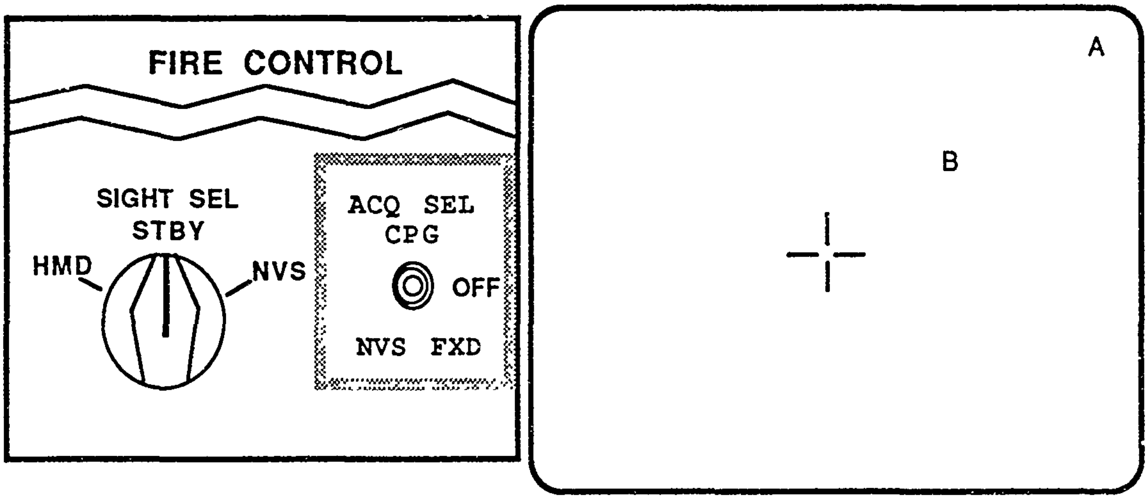


This is the **Cued Line-of-Sight (LOS) Reticle.**

The Cued LOS Reticle serves two functions:

- to indicate the relative position of the CPG's LOS, and
- to indicate the computed rounds impact point for the 30mm gun.

Nothing is highlighted in green. Letters are not shown. Left-hand segment of Fire Control Panel is shown on left. Blue box is drawn around ACQ SEL switch, which is shown in "OFF" position.



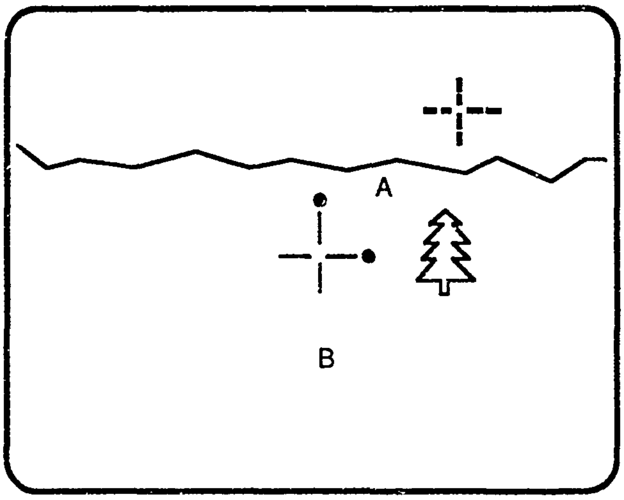
After the pilot has placed the ACQ SEL switch on the Fire Control Panel in the CPG position and the CPG's LOS is within 20 degrees of the pilot's LOS, the Cued LOS Reticle appears to indicate the location of the CPG's LOS in azimuth and elevation.

Press spacebar to simulate the pilot placing the ACQ SEL switch in the CPG position.

ACQ SEL switch is shown in "CPG" position. Top and right Cueing Dots appear. After 2 seconds, Cued LOS Reticle appears at position "A" and moves to position "B" in about 1 second.

Press spacebar to see demonstration again.

The Cued LOS Reticle is highlighted in green. Letters are not shown.



As shown in this display, the Cueing Dots and the Cued LOS Reticle indicate that the pilot must move his LOS (as represented by the LOS Reticle) upward and to the right to be coincident with the CPG's LOS.

The Cued LOS Reticle moves while the LOS Reticle remains stationary. When the pilot's LOS is within 4 degrees of the CPG's LOS, the Cueing Dots will blank.

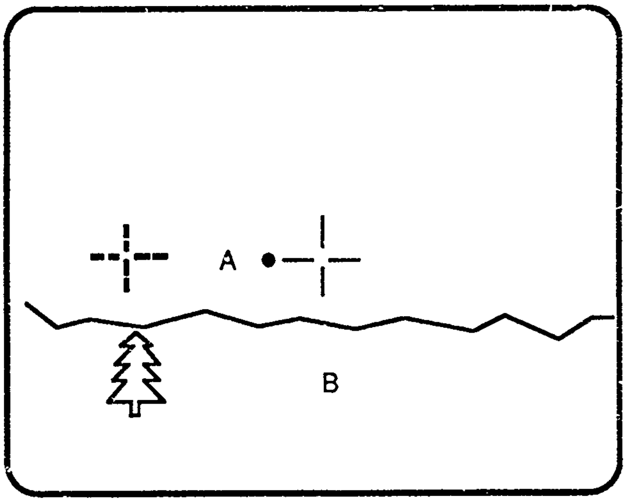
Press spacebar to simulate pilot moving his LOS upward and to the right.

After 2 seconds, Cued LOS Reticle moves downward and to the left until it overlaps the LOS Reticle, in about 1 second. At the same time, horizon and tree move downward and to the left from present position until tree is at position "B". Cueing Dots disappear from display when Cued LOS Reticle reaches position "A". Then add text:

Once the pilot has moved his LOS so that it is coincident with the CPG's LOS, the Cued LOS Reticle is superimposed on the LOS Reticle.

Press spacebar to see demonstration again.

The Cued LOS Reticle is highlighted in green. Letters are not shown.



As shown in this display, the Cueing Dot and the Cued LOS Reticle indicate that the pilot must move his LOS directly to the left to be coincident with the CPG's LOS.

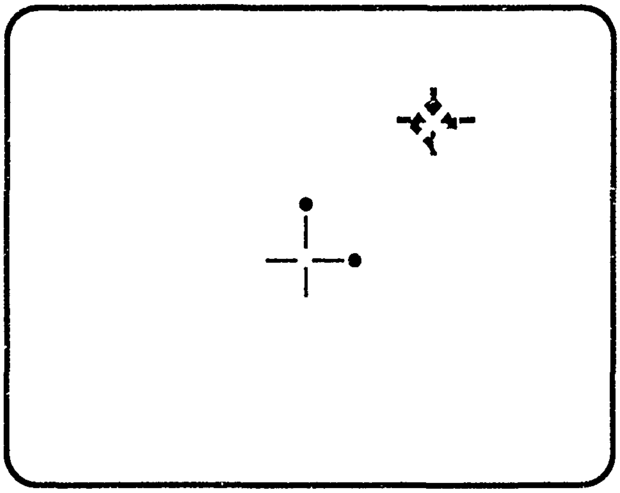
The Cued LOS Reticle moves while the LOS Reticle remains stationary.

Press spacebar to simulate pilot moving his LOS to the left.

After 2 seconds, Cued LOS Reticle moves to the right until it overlaps the LOS Reticle, in about 1 second. At the same time, horizon and tree move to the right from the present position until tree is at position "B". Cueing Dot disappears from the display when Cued LOS Reticle reaches position "A".

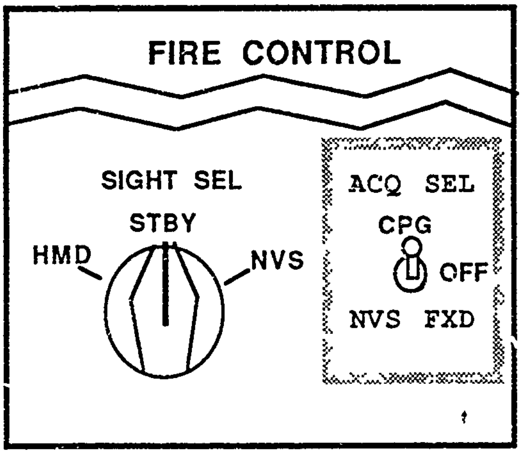
Press spacebar to see demonstration again.

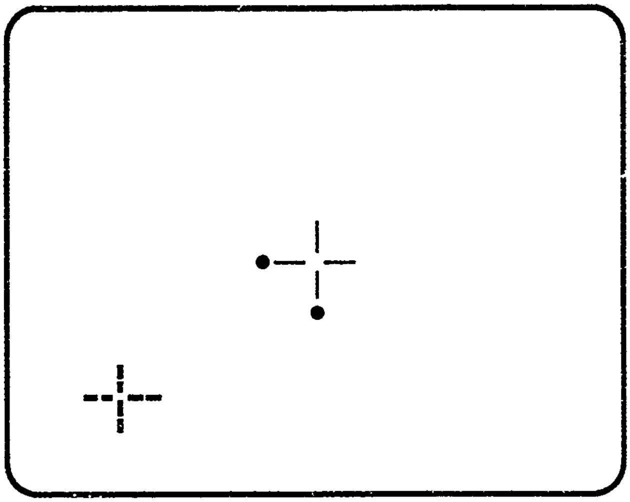
Cued LOS Reticle is highlighted in green.



When the Cued LOS Reticle overlapps the Head Tracker, the CPG's LOS is coincident with the helicopter centerline.

The Left-hand segment of Fire Control Panel is shown on left. Blue box is drawn around ACQ SEL switch, which is shown in the "CPG" position. The Cued LOS Reticle is highlighted in green.





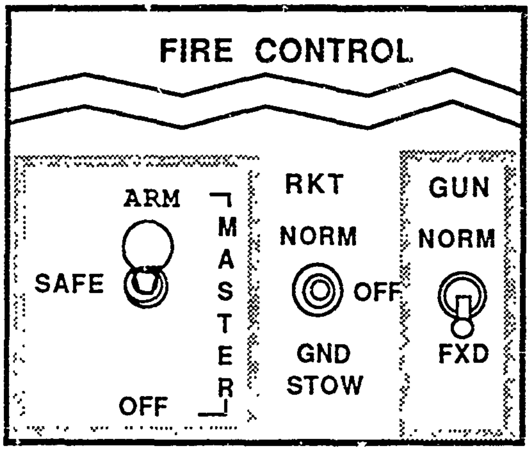
When the pilot turns the ACQ SEL switch to the "OFF" position, the Cued LOS Reticle disappears from the display. This may be desirable to declutter the display.

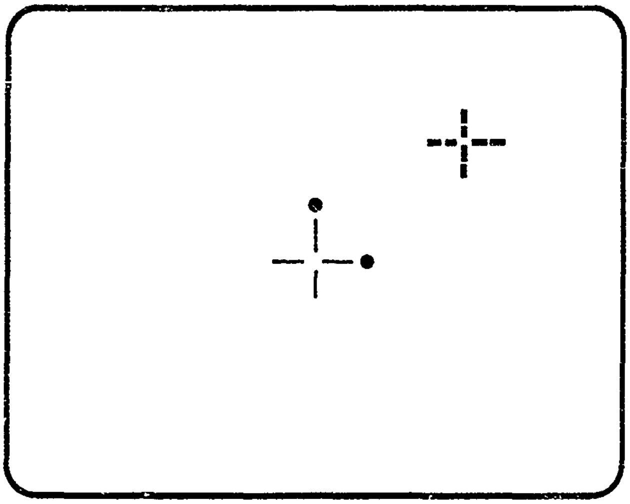
Press spacebar to simulate pilot turning ACQ SEL switch to "OFF" position.

ACQ SEL switch is shown in the "OFF" position; after .5 second, Cued LOS Reticle disappears from the display.

Press spacebar to see demonstration again.

Segment of Fire Control Panel is shown on left. Blue boxes are drawn around GUN switch (shown in "FXD" position) and MASTER switch (shown in "ARM" position). The Cued LOS Reticle is highlighted in green.





The second function of the Cued LOS Reticle is to indicate the computed rounds impact point for the machine gun when:

- the pilot places the GUN switch on the Fire Control Panel in the FXD position, and
- the pilot actions the gun system with the Master switch on the Fire Control Panel in either the safe or armed condition.

You have now completed the lesson on Central Cueing Symbols.

Please select what you would like to do now:

- Take the Quiz
- Return to the Main Menu

Symbology Tutor Quiz - Lesson 4a: Central Cueing/Reference Symbols

This quiz tests how much you learned about the Central Cueing/ Reference Symbols presented in Lesson 4a. The quiz consists of 17 multiple choice questions. Each answer has a small box associated with it. You will see a cross-shaped pointer just below the question and above the answer boxes. Use the arrow keys on the numeric keypad to move the pointer to the box next to your answer, then press ENTER to confirm your answer. You must answer each question correctly one time before you may leave the quiz.

Press ENTER to begin the quiz.

No Display Shown

The Head Tracker indicates:
1) the location of the helicopter centerline
2) the location of the pilot's head
3) the location of the pilot's LOS
4) the location of the CPG's LOS

Correct answer = 1. If response = 2, 3, or 4, go to IVa-T1.

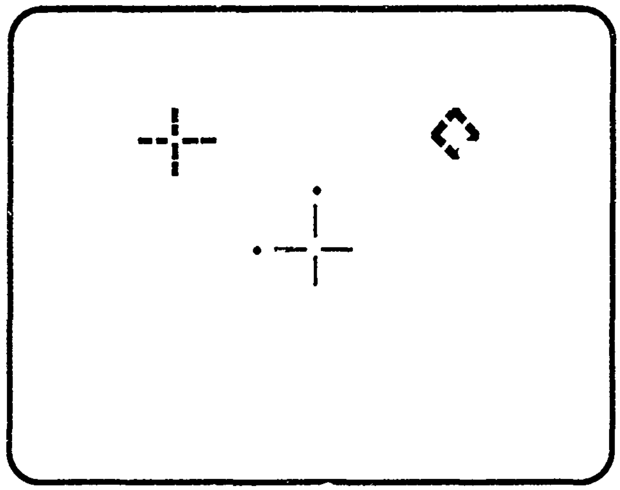
IVa-Q2

**No
Display
Shown**

The Head Tracker is displayed when the pilot's LOS is within:

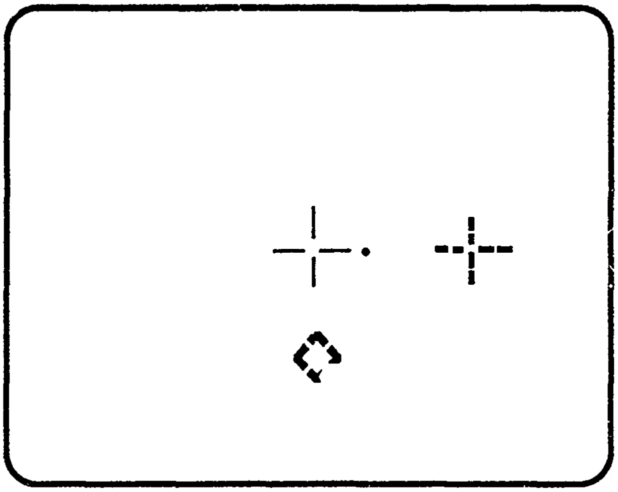
1) ±15 degrees azimuth and ±20 degrees elevation of the helicopter's centerline
2) ±20 degrees azimuth and ±15 degrees elevation of the helicopter's centerline
3) ±30 degrees azimuth and ±40 degrees elevation of the helicopter's centerline
4) ±40 degrees azimuth and ±30 degrees elevation of the helicopter's centerline

Correct answer = 2. If response = 1, 3, or 4, go to IVa-T2.



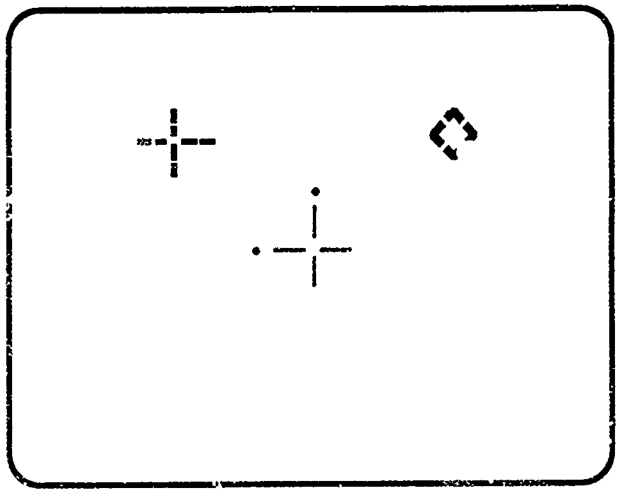
As shown in this display, the pilot's LOS is:
1) below and to the left of the helicopter centerline
2) below and to the right of the helicopter centerline
3) above and to the left of the helicopter centerline
4) above and to the right of the helicopter centerline

Correct answer = 1. If response = 2, 3, or 4, go to IVa-T5.



As shown in this display, the pilot's LOS is approximately:
1) 7.5 degrees above the helicopter centerline
2) 7.5 degrees below the helicopter centerline
3) 10 degrees to the left of the helicopter centerline
4) 10 degrees to the right of the helicopter centerline

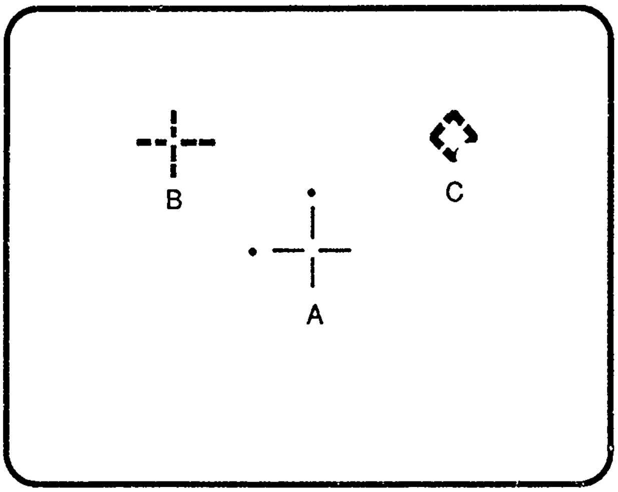
Correct answer = 1. If response = 2, 3, or 4, go to IVa-T3.



As shown in this display, in order for the pilot's LOS to be coincident with the helicopter centerline, the pilot should move his LOS:
1) upward and to the left
2) upward and to the right
3) downward and to the left
4) downward and to the right

Correct answer = 2. If response = 1, 3, or 4, go to IVa-T11.

Letters are shown in blue.



According to the symbology shown in this display, as the pilot moves his LOS to be coincident with the helicopter centerline:

1) symbol "A" moves upward and to the left while symbol "B" remains stationary
2) symbol "B" moves downward and to the right while symbol "A" remains stationary
3) symbol "A" moves upward and to the right while symbol "C" remains stationary
4) symbol "C" moves downward and to the left while symbol "A" remains stationary

Correct answer = 4. If response = 1, 2, or 3, go to IVa-T11.

No
Display
Shown

... the pilot moves hi[s] LOS more than 20 degrees away from the ...copter centerline ...he Head Tracker:
... begins flashing
... remains fixed ... edge of the display
... moves off the displ...
... appears on the oppo...e side of the display

Correct answer = 3. If response = 1, 2, or 4, go to IVa-17.

No
Display
Shown

When all four Cueing Dots are flashing, this indicates that:
1) an IHADDS boresight is required
2) the HARS has failed
3) the ADDS has failed
4) the LDNS has failed

Correct answer = 1. If response = 2, 3, or 4, go to IVa-T14.

No
Display
Shown

If the pilot selects cueing and a boresight is required:

1) all four Cueing Dots remain on in the steady state
2) all four Cueing Dots flash
3) the Cueing Dot(s) providing the cueing flash while the remaining Cueing Dots remain on in the steady state
4) the Cueing Dot(s) providing the cueing remain on in the steady state while the remaining Cueing Dots flash

Correct answer = 4. If response = 1, 2, or 3, go to IVa-T18.

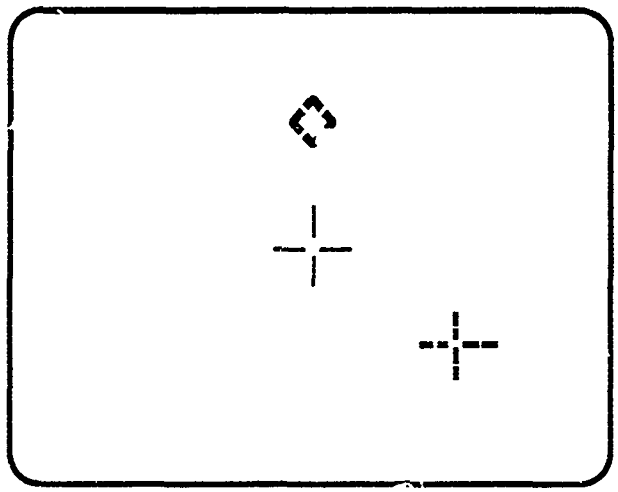
No Display Shown

One or more Cueing Dots appear when:

1) the pilot places the ACQ SEL switch in the CPG position and the CPG's LOS is less than 4 degrees from the pilot's LOS
2) the pilot places the ACQ SEL switch in the CPG position and the CPG's LOS is more than 4 degrees from the pilot's LOS
3) the pilot places the ACQ SEL switch in the PLT position and the CPG's LOS is less than 4 degrees from the pilot's LOS
4) the pilot places the ACQ SEL switch in the PLT position and the CPG's LOS is more than 4 degrees from the pilot's LOS

Correct answer = 2. If response = 1, 3, or 4, go to IVa-T15.

IVa-Q11



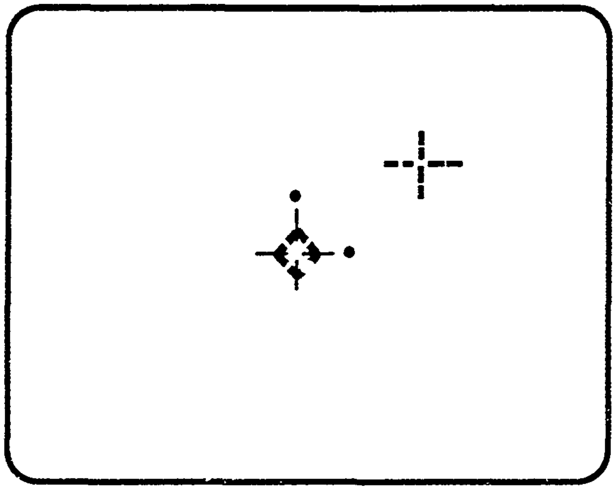
As shown in this display, which Cueing Dot(s) will appear?
1) only the top Cueing Dot
2) only the right Cueing Dot
3) both the left and bottom Cueing Dots
4) both the right and bottom Cueing Dots

Correct answer = 4. If response = 1, 2, or 3, go to IVa-T20.

No
Display
Shown

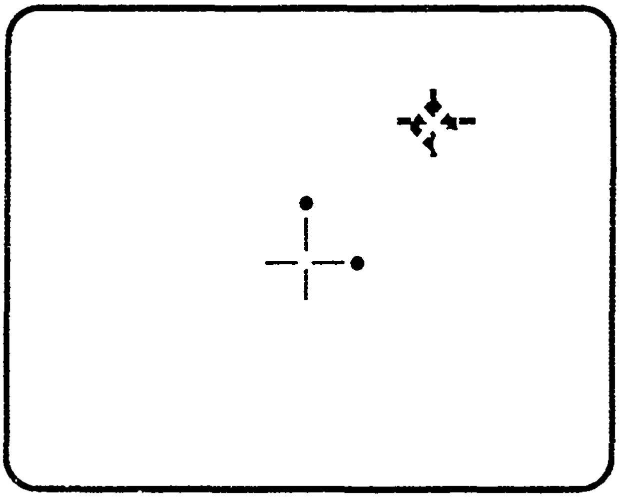
All the Cueing Dots blank when:
1) the pilot's LOS is within 10 degrees of the CPG's LOS
2) the pilot's LOS is within 4 degrees of the CPG's LOS
3) the ADSS fails
4) the HARS fails

Correct answer = 2. If response = 1, 3, or 4, go to IVa-T21.



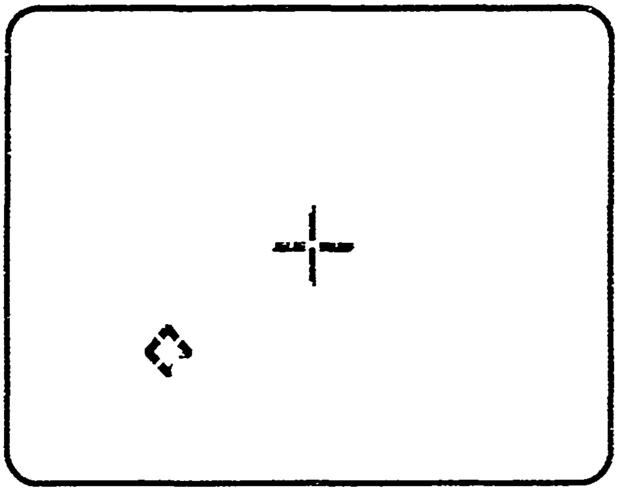
The symbology shown in this display indicates that:
1) the pilot's LOS is coincident with the helicopter centerline
2) the pilot's LOS is coincident with the CPG's LOS
3) the CPG's LOS is coincident with the helicopter centerline
4) the pilot has placed the ACQ SEL switch in the OFF position

Correct answer = 1. If response = 2, 3, or 4, go to IVa-T11.



The symbology shown in this display indicates that:
1) the pilot's LOS is coincident with the helicopter centerline
2) the pilot's LOS is coincident with the CPG's LOS
3) the CPG's LOS is coincident with the helicopter centerline
4) the pilot has placed the ACQ SEL switch in the OFF position

Correct answer = 3. If response = 1, 2, or 4, go to IVa-T23.



The symbology shown in this display indicates that:
1) the pilot's LOS is coincident with the helicopter centerline
2) the pilot's LOS is coincident with the CPG's LOS
3) the CPG's LOS is coincident with the helicopter centerline
4) the pilot has placed the ACQ SEL switch in the OFF position

Correct answer = 2. If response = 1, 3, or 4, go to IVa-T21.

No Display Shown

When the pilot turns the ACQ SEL switch to the OFF position:
1) the Cued LOS Reticle appears on the display
2) the Cued LOS Reticle disappears from the display
3) the Head Tracker appears on the display
4) the Head Tracker disappears from the display

Correct answer = 2. If response = 1, 3, or 4, go to IVa-T24.

No
Display
Shown

The Cued LOS Reticle indicates the computed rounds impact point of the machine gun when the pilot actions the gun system with the MASTER switch and:

1) the pilot places the ACQ SEL switch in the CPG position
2) the pilot places the ACQ SEL switch in the OFF position
3) the pilot places the GUN switch in the NORM position
4) the pilot places the GUN switch in the FXD position

Correct answer = 4. If response = 1, 2, or 3, go to IVa-T25.

Lesson 4b

Peripheral Cueing/Reference Symbols

The purpose of Lesson 4 is to teach you to identify and understand the meaning of symbols in the Flight Symbology set that give the pilot cueing and reference information. Lesson 4 is divided into two parts: Lesson 4a covers cueing/reference symbols that are located in the central part of the display; Lesson 4b covers cueing/reference symbols that are located in the lower part of the display.

You are now in Lesson 4b. The symbols covered in Lesson 4b are:

- The Field of Regard Box
- The Field of View Box
- The Cued LOS Dot

The symbols that are covered in Lesson 4a are:

- The Head Tracker
- The Cueing Dots
- The Cued LOS Reticle

You can go through Lesson 4a and 4b in any order; however, it is recommended that you go through Lesson 4a before proceeding to Lesson 4b.

The word "green" is shown in the color green, the word "blue" is shown in the color blue.

This lesson is divided into two parts: A Tutorial and a Quiz.

Tutorial

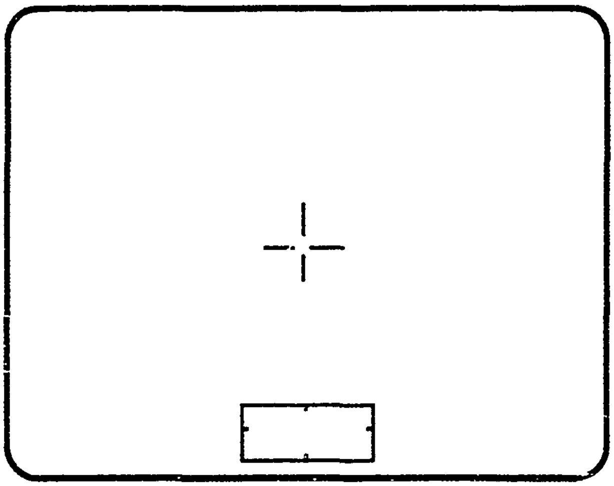
In the first part, a facsimile of an AH-64 visual display showing one symbol or a small group of symbols is shown on the top part of the screen. The symbol or symbols of interest are highlighted in **green** and described briefly below the display. Supplementary material that does not appear on the AH-64 display is shown in **blue**. In some cases, you will have the opportunity to see a brief demonstration of how the symbol or symbols move in the display.

The Line of Sight (LOS) Reticle (covered in Lesson 1) is included on each display in the tutorial to provide a general frame of reference.

Quiz

The second part of this lesson consists of a quiz covering the material you have just learned. If you answer a question incorrectly, you will briefly review the material covered in that question before proceeding with the quiz. After you have completed the quiz, you will have the opportunity to review the lesson again, go on to another lesson, or quit the program.

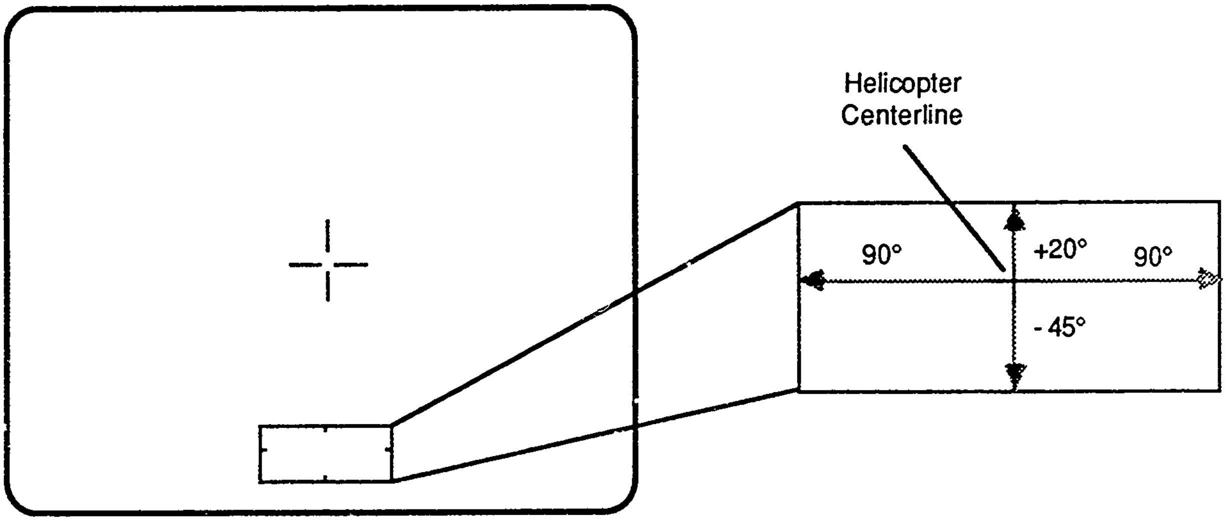
The Field of Regard Box is highlighted in green.



This is the **Field of Regard Box.**

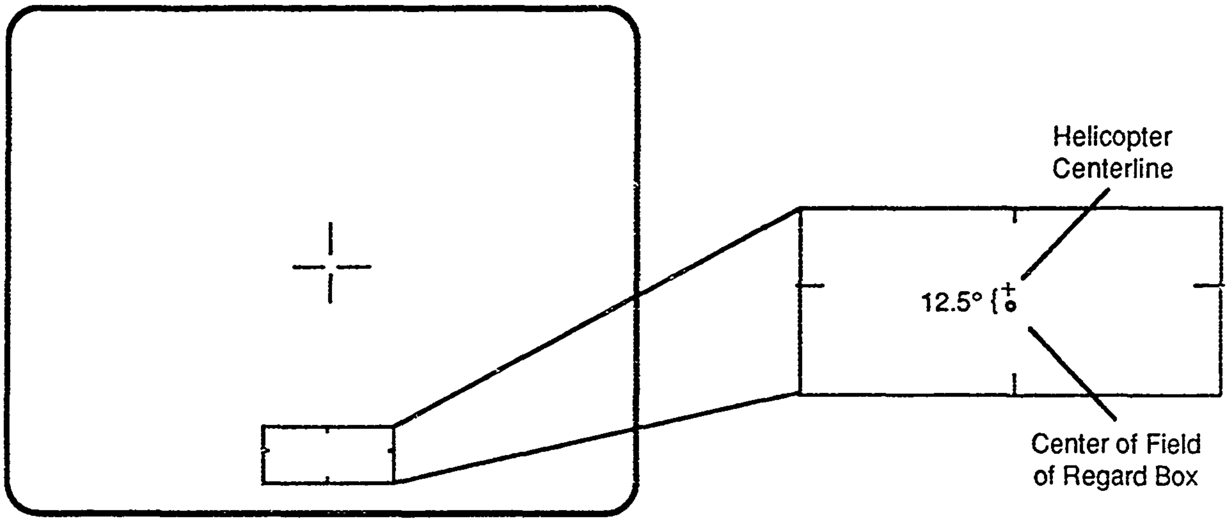
It represents the horizontal and vertical limits of the area that the PNVS is capable of viewing.

The Field of Regard Box is highlighted in green. Numbers and dotted lines in diagram are shown in blue.



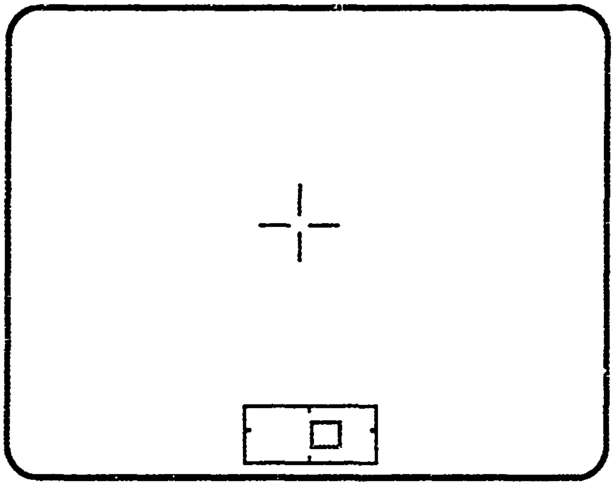
The PNVS Field of Regard is 90 degrees to the left and right of the helicopter centerline in azimuth and +20 to -45 degrees in elevation.

The Field of Regard Box is highlighted in green.
Words, lines, cross, and square are shown in blue.



As a result of the location of the PNVS Field of Regard, the helicopter centerline is actually 12.5 degrees above the center of the PNVS Field of Regard Box.

The Field of View Box is highlighted in green.

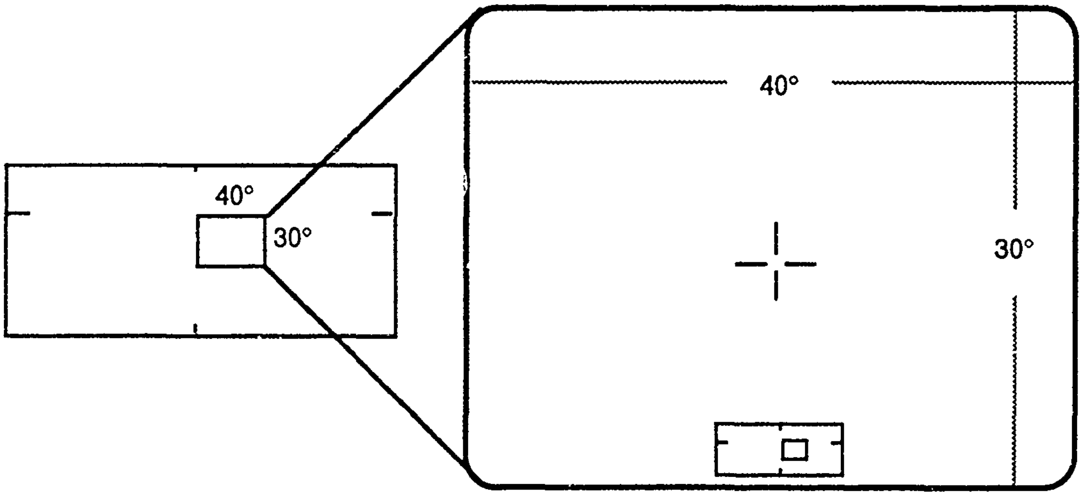


This is the **Field of View Box.**

It shows the instantaneous viewing area of the PNVS (where the pilot is looking) within the Field of Regard.

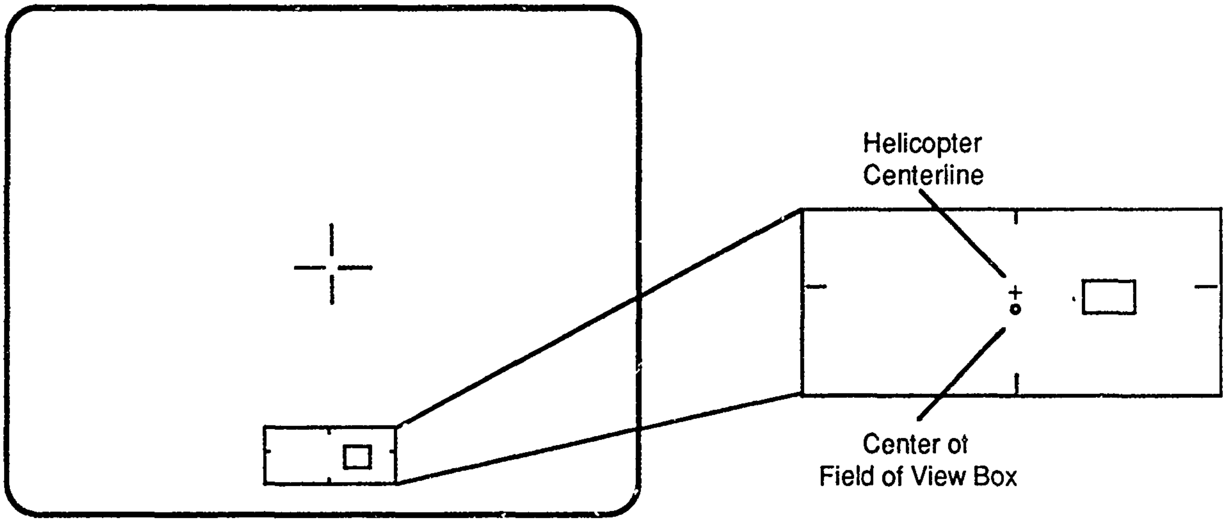
The center of the Field Of View Box represents the pilot's LOS.

The Field of View Box is highlighted in green.
Dotted lines and numbers are shown in blue.



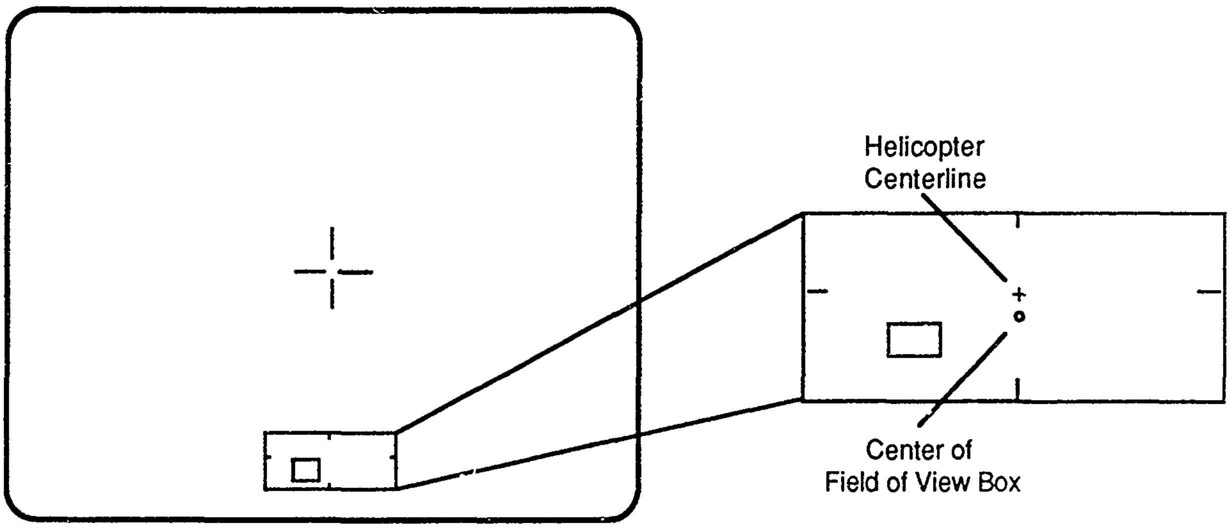
The Field of View Box represents a miniature version of the entire 40 degree azimuth by 30 degree elevation PNVS display.

The Field of View Box is highlighted in green.



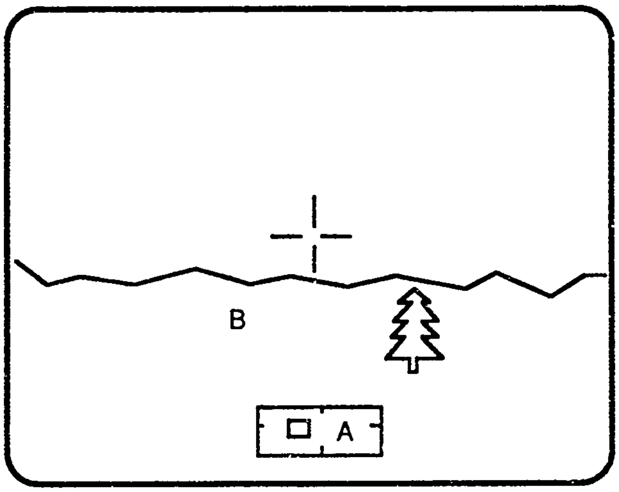
As shown in this display, the pilot is looking directly to the right of the helicopter centerline.

The Field of View Box is highlighted in green.



As shown in this display, the pilot is looking below and to the left of the helicopter centerline.

The Field of View Box is highlighted in green. Letters are not shown.



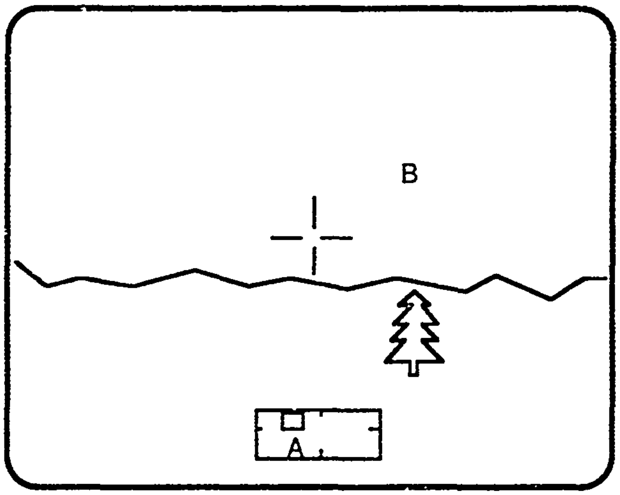
The Field of View Box moves in the <u>same</u> direction the pilot moves his LOS. In this case, the pilot is moving his LOS from the left of the helicopter centerline to the right of the centerline.

Press spacebar to simulate pilot moving his LOS from left to right.

Field of View Box moves from its present position to position "A" in about 1 second. At the same time, horizon and tree move to the left from the present position until tree is at position "B".

Press spacebar to see demonstration again.

The Field of View Box is highlighted in green. Letters are not shown.



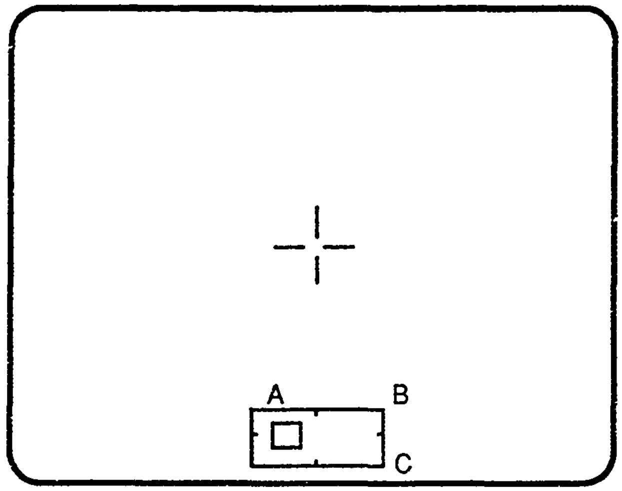
In this case, thʟ pilot is moving his LOS from above the helicopter centerline to a position below the centerline.

Press spacebar to simulate pilot moving his LOS downward.

Field of View Box moves from its present position downward to position "A" in about 1 second. At the same time, horizon and tree move upward from the present position until tree is at position "B".

Press spacebar to see demonstration again.

The Field of View Box is highlighted in green. Letters are not shown.



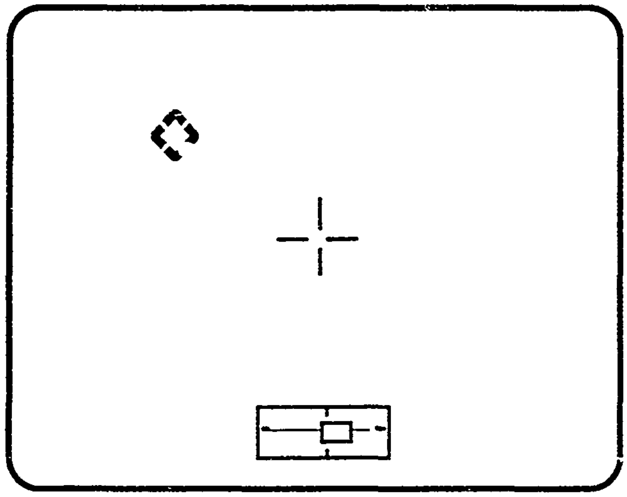
When the pilot moves his LOS beyond the sensor limits of the PNVS, the Field of View Box moves slightly beyond the borders of the Field of Regard Box.

Press spacebar to simulate pilot moving his LOS beyond the limits of the PNVS Field of Regard.

Field of View Box moves from present position to position "A", then position "B", and finally position "C". At positions "A", "B", and "C", the Field of View Box is completely outside of the Field of Regard Box. The entire sequence takes about 3 seconds.

Press spacebar to see demonstration again.

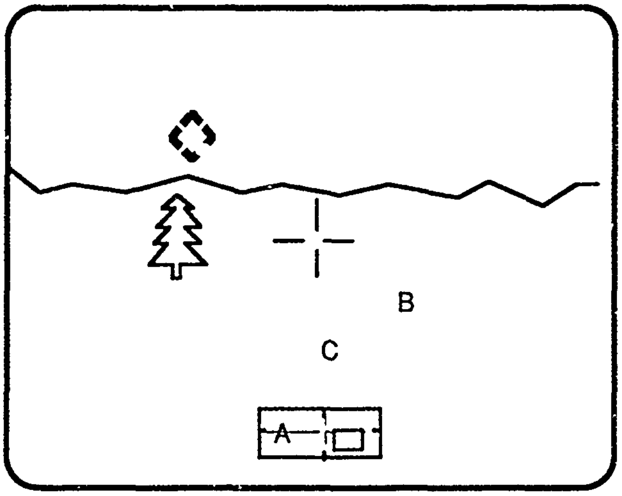
The Field of View Box is highlighted in green.



The location of the Field of View Box within the Field of Regard Box gives the same information about the pilot's LOS as the location of the Head Tracker in relation to the LOS Reticle.

As shown in this display, both the Field of View Box and the Head Tracker indicate that the pilot's LOS is below and to the right of the helicopter centerline.

The Field of View Box is highlighted in green.



As the pilot moves his LOS upward and to the left:

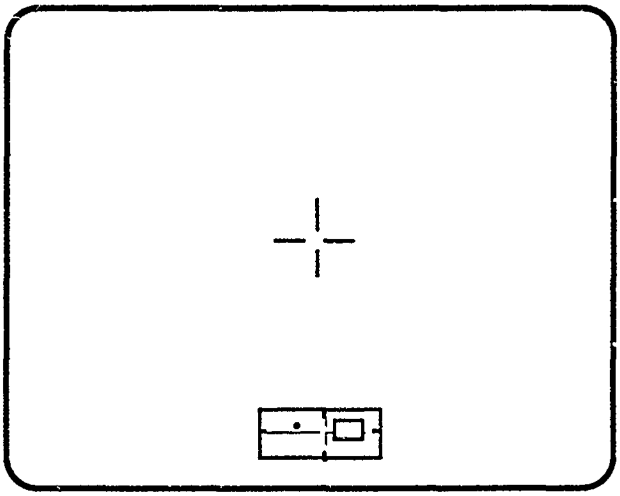
- the Field of View Box moves in the same direction that the pilot moves his LOS - upward and to the left, and
- the Head Tracker moves in the opposite direction that the pilot moves his LOS - downward and to the right.

Press spacebar to simulate pilot moving his LOS upward and to the left.

Field of View Box moves upward and to the left to position "A" while the Head Tracker moves downward and to the right to position "B". At the same time, horizon and tree move downward and to the right until tree is at position "C". The sequence takes about 1 second.

Press spacebar to see demonstration again.

The Cued LOS Dot is highlighted in green.

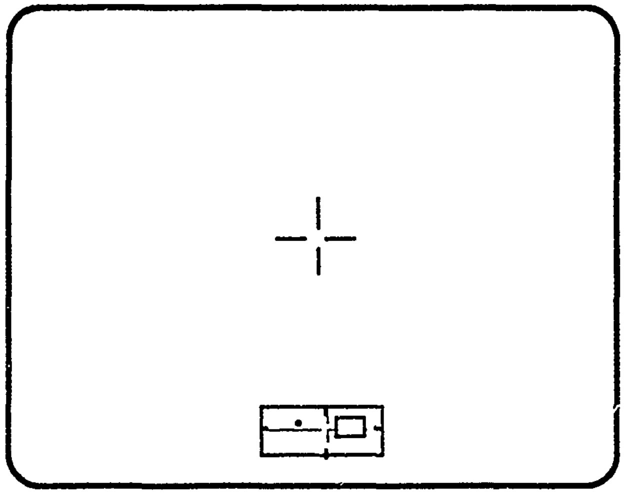


This is the **Cued LOS Dot**.

It shows the CPG's LOS in azimuth and elevation within the PNVS Field of Regard.

Its purpose is to cue the pilot to the location of the CPG's LOS:
- within the Field of Regard, and
- in relation to the pilot's LOS (the center of the Field of View Box).

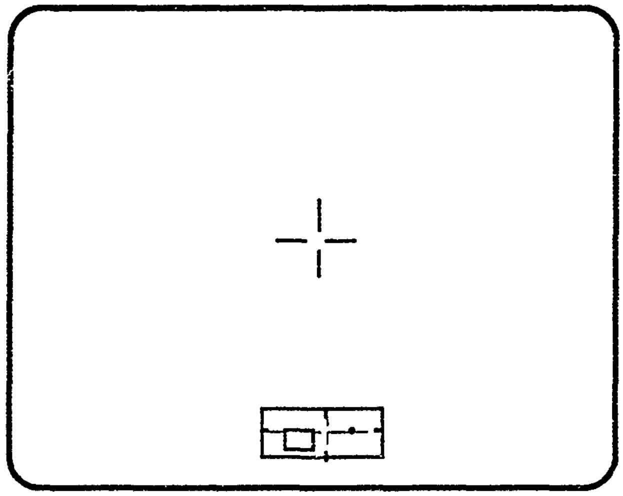
The Cued LOS Dot is highlighted in green.



As shown in this display, the location of the Cued LOS Dot indicates that the CPG's LOS is:

- to the left of and slightly above the helicopter centerline, and
- directly to the left of the pilot's LOS.

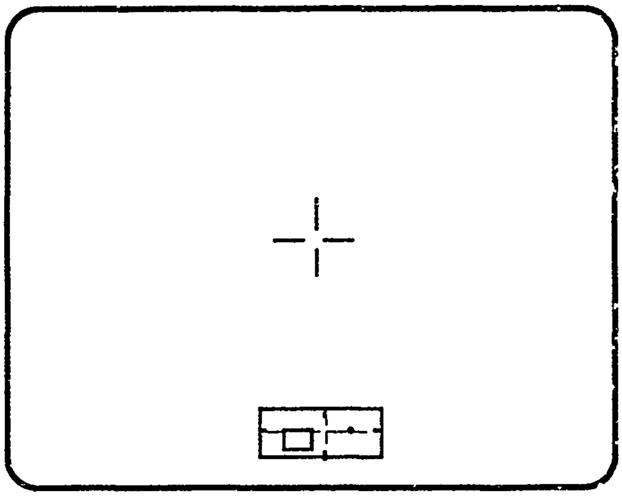
The Cued LOS Dot is highlighted in green.



In this display, the location of the Cued LOS Dot indicates that the CPG's LOS is:

- directly to the right of the helicopter centerline,
- outside the pilot's sensor Field of View, and
- above and to the right of the pilot's LOS.

The Field of View Box is highlighted in green.



In order for the pilot's LOS to be coincident with the CPG's LOS, the pilot should move his LOS so that the Field of View Box overlaps the Cued LOS Dot.

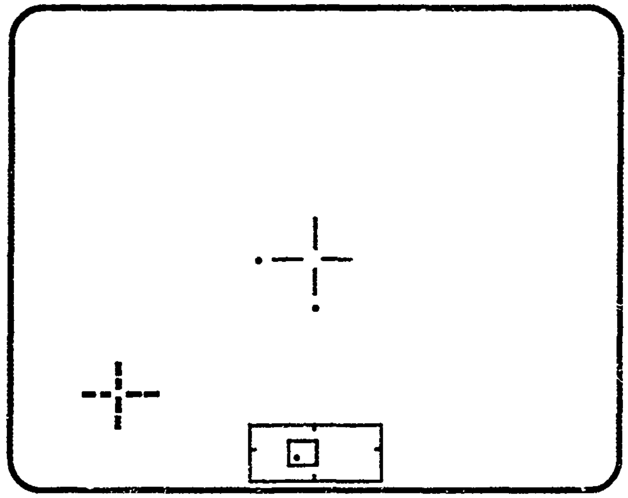
As shown in this display, the pilot should move his LOS upward and to the right to be coincident with the CPG's LOS.

Press spacebar to simulate pilot moving his LOS upward and to the right.

Field of View Box moves upward and to the right until it is centered on the Cued LOS Dot.

Press spacebar to see demonstration again.

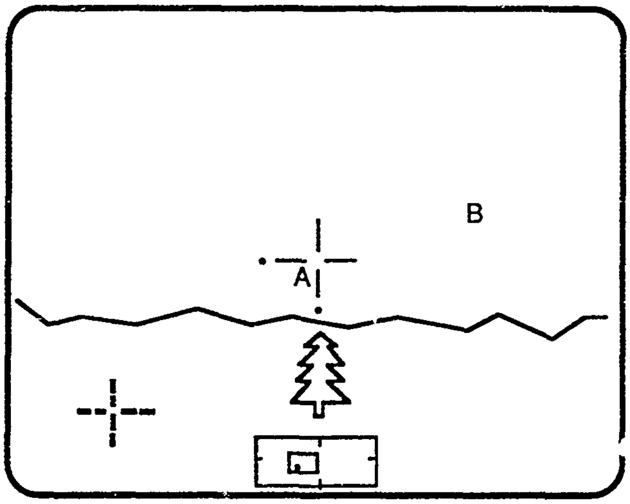
The Cued LOS Reticle is highlighted in green.



The location of the Cued LOS Dot within the Field of View Box gives the same information about the CPG's LOS as the location of the Cued LOS Reticle in relation to the LOS Reticle.

In this case, the CPG's LOS is within the pilot's Field of View, but is slightly below and to the left of the pilot's LOS.

The Cued LOS Reticle is highlighted in green. Letter is not shown.



As the pilot moves his LOS downward and to the left so that his LOS is coincident with the CPG's LOS:

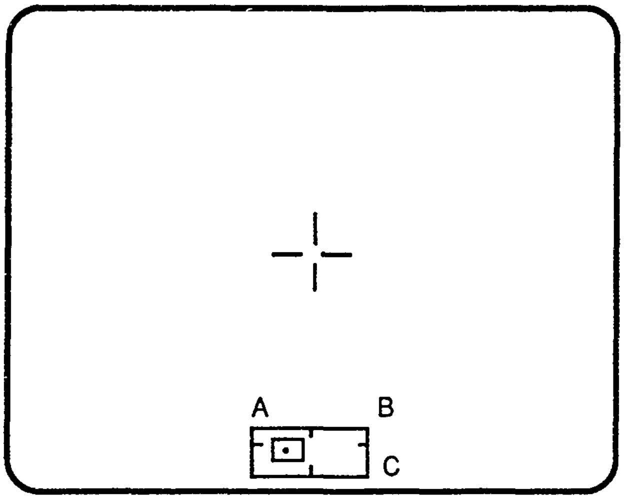
- the Cued LOS Dot will be in the middle of the Field of View Box, and
- the Cued LOS Reticle and the Pilot's LOS will overlap.

Press spacebar to simulate pilot moving his LOS downward and to the left.

The Cued LOS Reticle moves upward and to the right until it overlaps the LOS Reticle while the Field of View Box moves downward and to the left until it is centered over the Cued LOS Dot. At the same time, horizon and tree move upward and to the right until tree is at position "B". The sequence takes about 2 seconds. Cueing Dots disappear from display when Cued LOS Reticle reaches position "A".

Press spacebar to see demonstration again.

The Cued LOS Dot is highlighted in green. Letters are not shown.

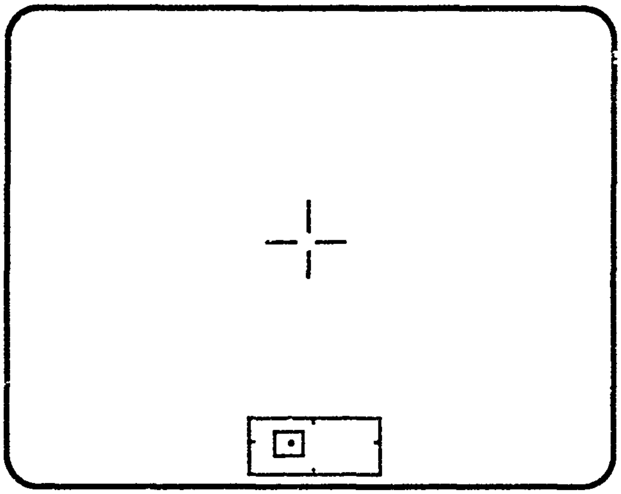


When the CPG moves his LOS beyond the sensor limits of the PNVS, the Cued LOS Dot moves slightly beyond the borders of the Field of Regard Box.

Press spacebar to simulate CPG moving his LOS beyond the limits of the PNVS Field of Regard.

Cued LOS Dot moves from present position to position "A", then position "B", and finally position "C". At positions "A", "B", and "C", the Cued LOS Dot is completely outside the Field of Regard Box. The entire sequence takes about 3 seconds.

The Cued LOS Dot is highlighted in green.



The Cued LOS Dot flashes when the HARS internal platform goes into the free inertial mode (failed), usually as a result of the doppler navigation system being in memory.

Press spacebar to simulate HARS failure.

Cued LOS Dot flashes at rate of .75 sec on/.25 sec off.

Press spacebar to see demonstration again.

You have now completed the lesson on Peripheral Cueing Symbols.

Please select what you would like to do now:

- Take the Quiz
- Return to the Main Menu

Symbology Tutor Quiz - Lesson 4b: Peripheral Cueing/Reference Symbols

This quiz tests how much you learned about the Peripheral Cueing/ Reference Symbols presented in Lesson 4b. The quiz consists of 18 multiple choice questions. Each answer has a small box associated with it. You will see a cross-shaped pointer just below the question and above the answer boxes. Use the arrow keys on the numeric keypad to move the pointer to the box next to your answer, then press ENTER to confirm your answer. You must answer each question correctly one time before you may leave the quiz.

Press ENTER to begin the quiz.

IVb-Q1

No
Display
Shown

The Field of Regard Box represents:
1) the instantaneous viewing area of the PNVS
2) a miniature version of the PNVS display
3) the horizontal and vertical limits of the area that the PNVS is capable of viewing
4) the horizontal and vertical limits of the Cued LOS Reticle

Correct answer = 3. If response = 1, 2, or 4, go to IVb-T1.

**No
Display
Shown**

The limits of the Field of Regard Box are:
1) ±90 in azimuth and +45, -20 degrees in elevation
2) ±90 in azimuth and +20, -45 degrees in elevation
3) ±110 in azimuth and +45, -20 degrees in elevation
4) ±110 in azimuth and +20, -45 degrees in elevation

Correct answer = 2. If response = 1, 3, or 4, go to IVb-T2.

**No
Display
Shown**

The center of the Field of Regard Box is:
1) the same as the location of the helicopter centerline
2) the same as the location of the Field of View Box
3) 12.5 degrees above the helicopter centerline
4) 12.5 degrees below the helicopter centerline

Correct answer = 4. If response = 1, 2, or 3, go to IVb-T3.

IVb-Q4

No Display Shown

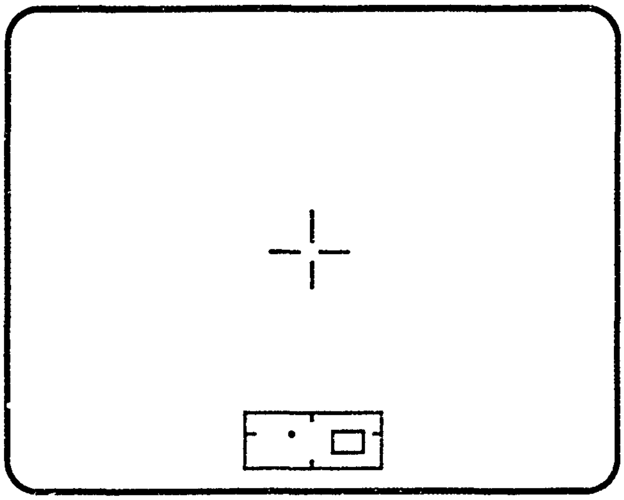
The Field of View Box indicates:
1) the instantaneous viewing area of the PNVS within the Field of View
2) the instantaneous viewing area of the PNVS within the Field of Regard
3) the horizontal and vertical limits of the PNVS viewing area
4) the horizontal and vertical limits of the centerline

Correct answer = 2. If response = 1, 3, or 4, go to IVb-T4.

No
Display
Shown

The Field of View Box represents a viewing area of what dimensions?
1) 15 degrees azimuth by 20 degrees elevation
2) 20 degrees azimuth by 15 degrees elevation
3) 30 degrees azimuth by 40 degrees elevation
4) 40 degrees azimuth by 30 degrees elevation

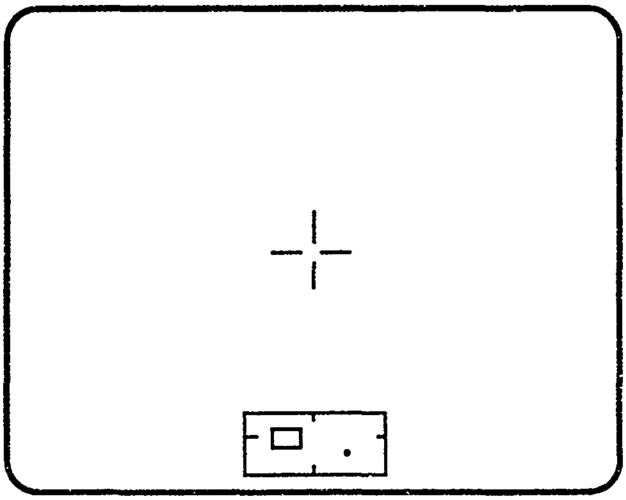
Correct answer = 4. If response = 1, 2, or 3, go to IVb-T5.



The symbology shown in this PNVS display indicates that the pilot's LOS is:

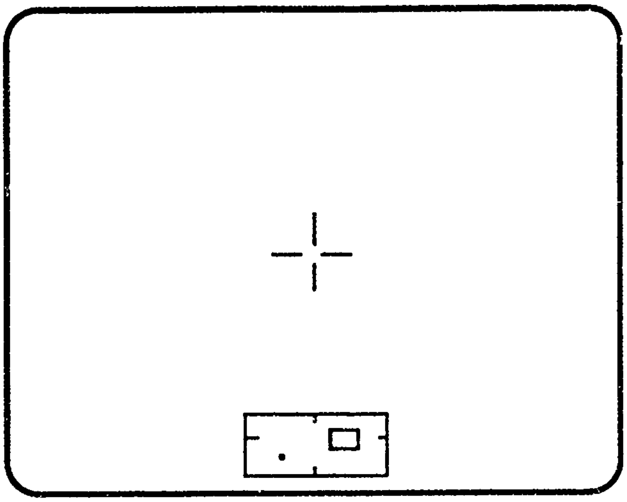
1) directly to the left of the helicopter centerline
2) directly to the right of the helicopter centerline
3) below and to the right of the helicopter centerline
4) below and to the left of the helicopter centerline

Correct answer = 3. If response = 1, go to IVb-T7, IV-T13; if 2 or 4, go to IVb-T7.



The symbology shown in this PNVS display indicates that the CPG's LOS is:
1) directly to the left of the helicopter centerline
2) directly to the right of the helicopter centerline
3) above and to the left of the helicopter centerline
4) below and to the right of the helicopter centerline

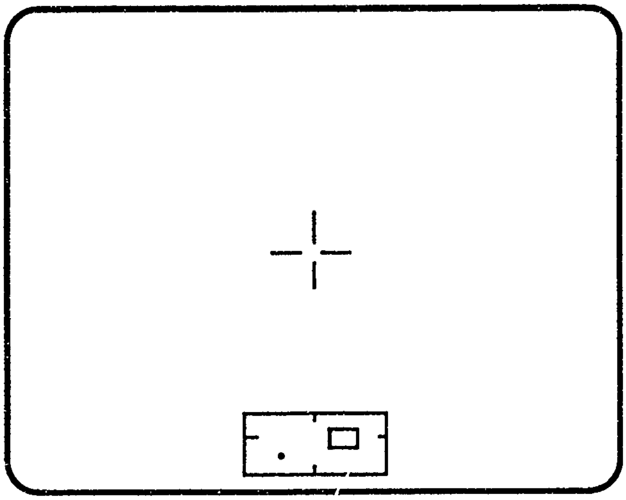
Correct answer = 4. If response = 1, go to IVa-T15, IVa-T4; if 2 or 3, go to IVa-T15.



According to the symbology shown in this PNVS display, the pilot should move his LOS in what direction to be coincident with the CPG's LOS:

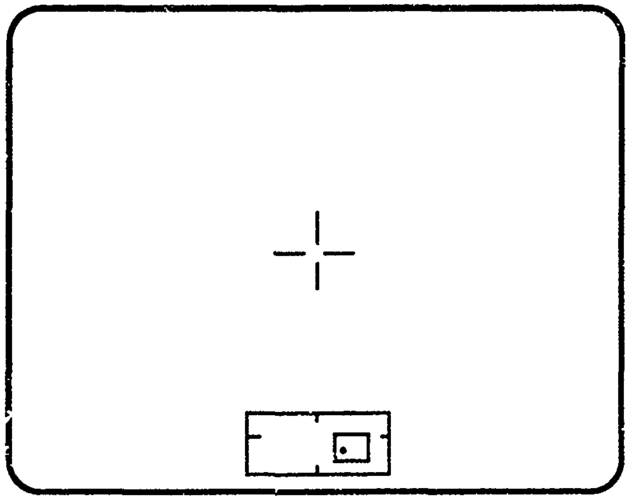
1) upward and to the left
2) upward and to the right
3) downward and to the left
4) downward and to the right

Correct answer = 3. If response = 1, go to IVb-T13, IVb-T16; if 2 or 4, go to IVb-T16.



According to the symbology shown in this PNVS display, the pilot's LOS is coincident with the CPG's LOS when:
1) the Cued LOS Dot is at the middle of the Field of Regard Box
2) the Cued LOS Dot is at the middle of the LOS Reticle
3) the Cued LOS Reticle is at the middle of the Field of Regard Box
4) the Cued LOS Dot is at the middle of the Field of View Box

Correct answer = 4. If response = 1, 2, or 3, go to IVb-T16.



According to the symbology shown in this PNVS display, the CPG's LOS is:
1) below and to the left of the pilot's LOS and within the pilot's field of view
2) below and to the left of the pilot's LOS and outside the pilot's field of view
3) above and to the right of the pilot's LOS and within the pilot's field of view
4) above and to the right of the pilot's LOS and outside the pilot's field of view

Correct answer = 1. If response = 2, 3, or 4, go to IVb-T17.

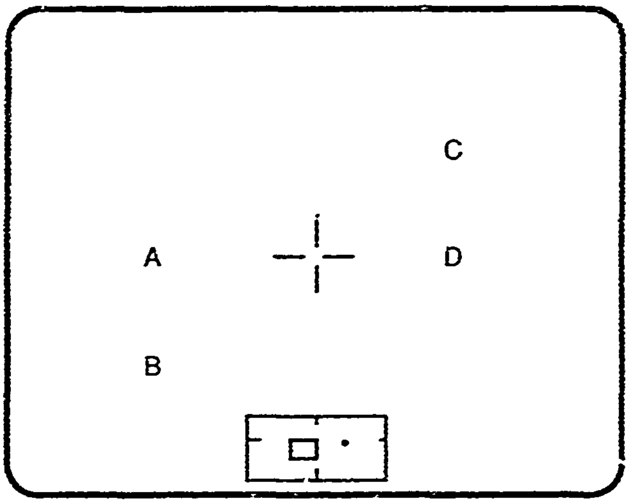
No Display Shown

When the pilot moves his LOS beyond the sensor limits of the PNVS, the Field of View Box will:

1) disappear from the screen
2) flash at a rate of .75 seconds on/.25 seconds off
3) remain within the borders of the Field of Regard Box
4) move slightly beyond the borders of the Field of Regard Box

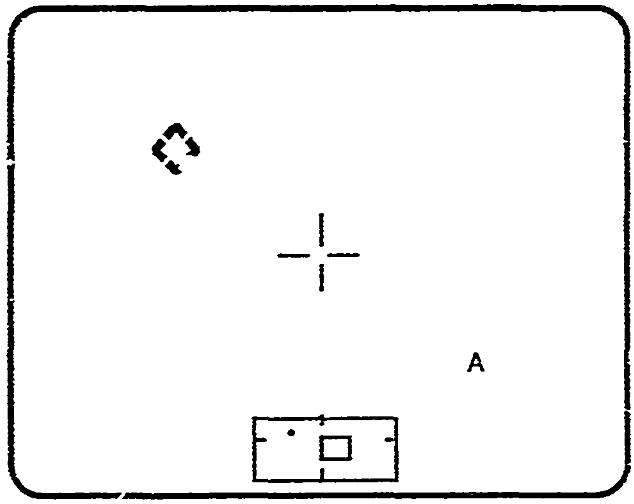
Correct answer = 4. If response = 1, 2, or 3, go to IVb-T19.

Letters are shown in blue.



According to the symbology shown in this PNVS display, the Head Tracker is located at which position:
1) position "A"
2) position "B"
3) position "C"
4) position "D"

Correct answer = 3. If response = 1, 2, or 4, go to IVb-T11.



According to the symbology shown in this PNVS display, if the Head Tracker moves to position "A", the Field of View Box will move:

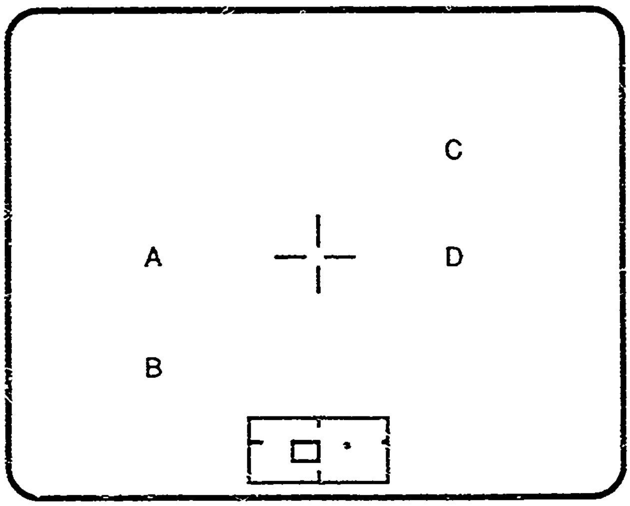
1) upward and to the left
2) upward and to the right
3) downward and to the left
4) downward and to the right

Correct answer = 1. If response = 2, 3, or 4, go to IVb-T12.

**No
Display
Shown**

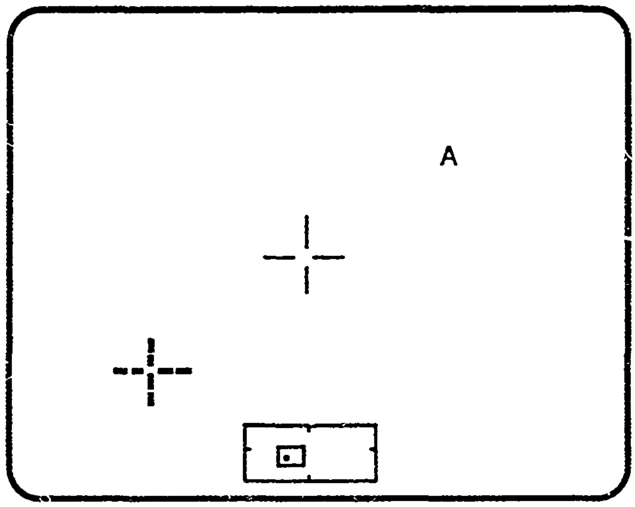
The Cued LOS Dot indicates:
1) the location of pilot's LOS within the Field of Regard
2) the location of CPG's LOS within the Field of Regard
3) the direction the pilot should look for his LOS to be coincident with the CPG's LOS
4) the direction the CPG should look for his LOS to be coincident with the pilot's LOS

Correct answer = 2. If response = 1, 3, or 4, go to IVb-T13.



According to the symbology shown in this PNVS display, the Cued LOS Reticle is located at which position:
1) position "A"
2) position "B"
3) position "C"
4) position "D"

Correct answer = 3. If response = 1, 2, or 4, go to IVb-T17.



According to the symbology shown in this PNVS display, if the Cued LOS Reticle moves to position "A", the Cued LOS Dot will move:

1) upward and to the left
2) upward and to the right
3) downward and to the left
4) downward and to the right

Correct answer = 2. If response = 1, 3, or 4, go to IVb-T18.

IVb-Q17

No
Display
Shown

When the CPG moves his LOS beyond the sensor limits of the PNVS, the Cued LOS Dot will:

1) remain within the borders of the Field of Regard Box
2) move slightly beyond the borders of the Field of Regard Box
3) flash at a rate of .75 seconds on/.25 seconds off
4) disappear from the screen

Correct answer = 2. If response = 1, 3, or 4, go to IVb-T19.

IVb-Q18

No
Display
Shown

The Cued LOS Dot flashes when:
1) the ADSS fails
2) the Radar Altimeter fails
3) the LDNS fails
4) the HARS fails

Correct answer = 4. If response = 1, 2, or 3, go to IVb-T20.

APPENDIX E

SYMBOLOGY TUTOR STORYBOARDS FOR LESSON 5:
WEAPONS USAGE SYMBOLS

Lesson 5

Weapons Usage Symbols

The purpose of this lesson is to teach you to identify and understand the meaning of symbols in the Flight Symbology set that give the pilot information about the use of the machine gun, the rockets, and the missiles.

The symbols covered in this lesson are:

- The Cued LOS Reticle
- The Rocket Steering Cursor
- The Fixed Rocket Steering Cursor
- The Missile Constraints Box (Lock-On-Before-Launch)
- The Missile Constraints Box (Lock-On-After-Launch)

The word "green" is shown in the color green, the word "blue" is shown in the color blue.

This lesson is divided into two parts: A Tutorial and a Quiz.

Tutorial

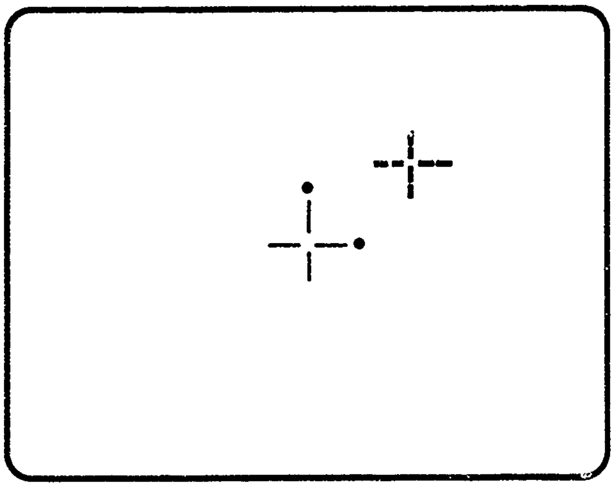
In the first part, a facsimile of an AH-64 visual display showing one symbol or a small group of symbols is shown on the top part of the screen. The symbol or symbols of interest are highlighted in **green** and described briefly below the display. Supplementary material that does not appear on the AH-64 display is shown in **blue**. In some cases, you will have the opportunity to see a brief demonstration of how the symbol or symbols move in the display.

The Line of Sight (LOS) Reticle (covered in Lesson 1) is included on the Tutorial displays to provide a general frame of reference.

Quiz

The second part of this lesson consists of a quiz covering the material you have just learned. If you answer a question incorrectly, you will briefly review the material covered in that question before proceeding with the quiz. After you have completed the quiz, you will have the opportunity to review the lesson again, go on to another lesson, or quit the program.

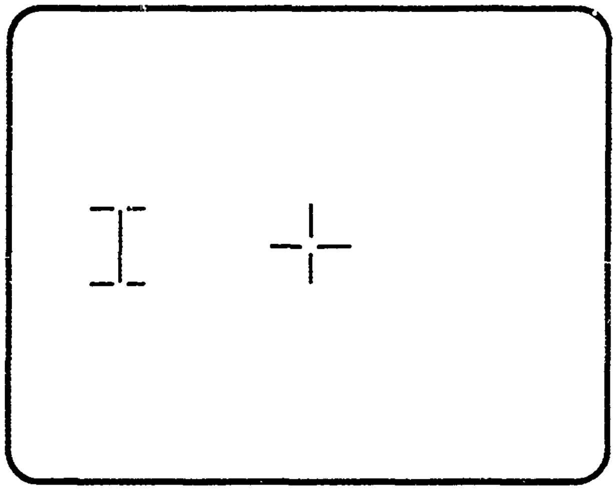
The Cued LOS Reticle is highlighted in green.



The Cued LOS Reticle represents the computed rounds impact point for the gun when:

- the pilot places the GUN switch on the Fire Control Computer (FCC) panel in the FXD position, and
- the pilot actions the gun system with the Master switch on the Pilot FCC panel in either the safe or armed condition

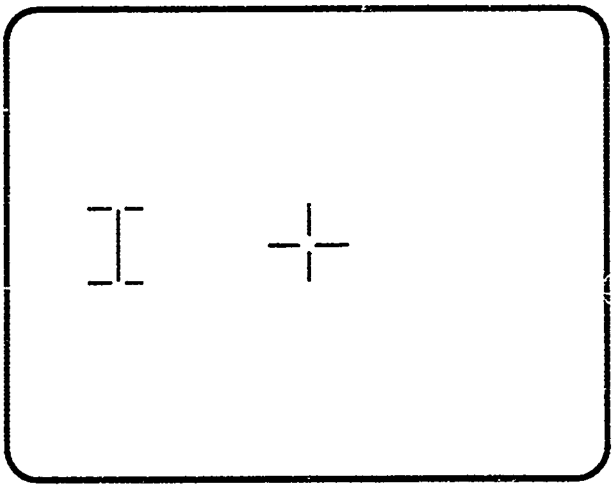
The Rocket Steering Cursor is highlighted in green.



This is the **Rocket Steering Cursor.**

It indicates the orientation required to align the helicopter (as represented by the LOS Reticle) into constraints for rocket engagements when the airspeed of the helicopter is less than 100 knots.

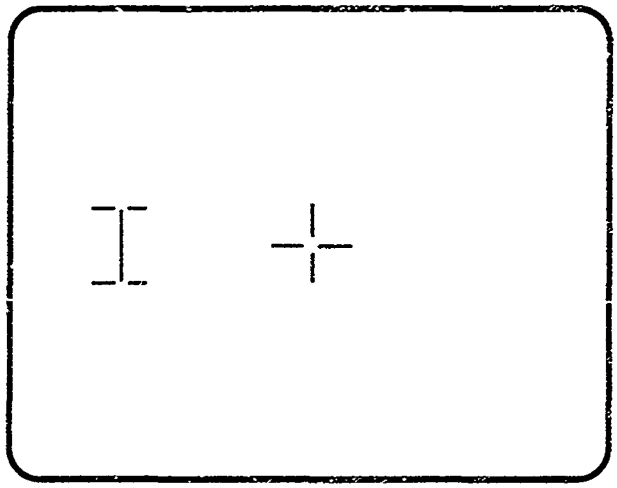
The Rocket Steering Cursor is highlighted in green.



The Rocket Steering Cursor is displayed to the pilot when:

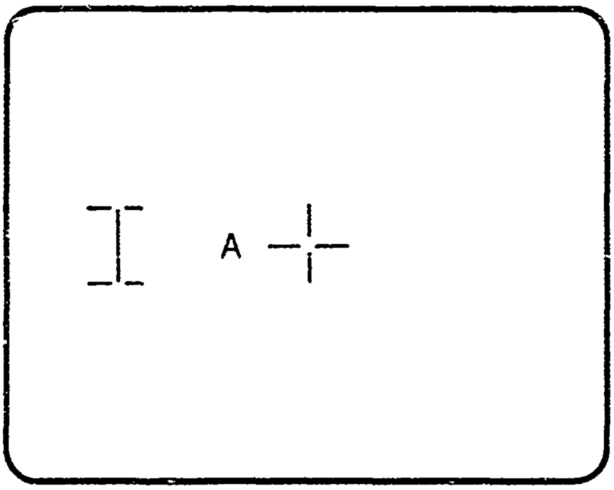
- either the pilot or the CPG actions the rocket system,
- at least one crewmember has the RKT switch (on the FCC panel) in the NORM position,
- the opposite crewmember's RKT switch is not in the GND STOW position, and
- the airspeed of the helicopter is less than 100 knots.

The Rocket Steering Cursor is highlighted in green.



As shown in this display, the location of the Rocket Steering Cursor indicates that the pilot should turn the helicopter to the left to be in constraints for using the rockets.

The Rocket Steering Cursor is highlighted in green. Letter is not shown.



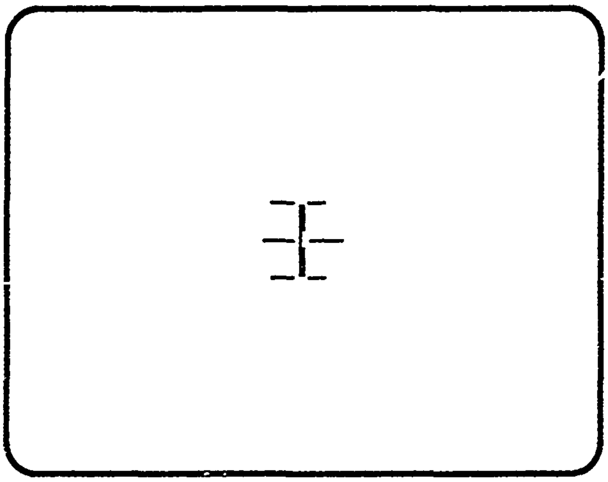
As the pilot turns the helicopter (represented by the LOS Reticle) to the left, the Rocket Steering Cursor moves to the right in the direction of the LOS Reticle, which remains stationary.

Press spacebar to simulate pilot turning the helicopter to the left.

The Rocket Steering Cursor moves from its present position to position "A" in about 1 second.

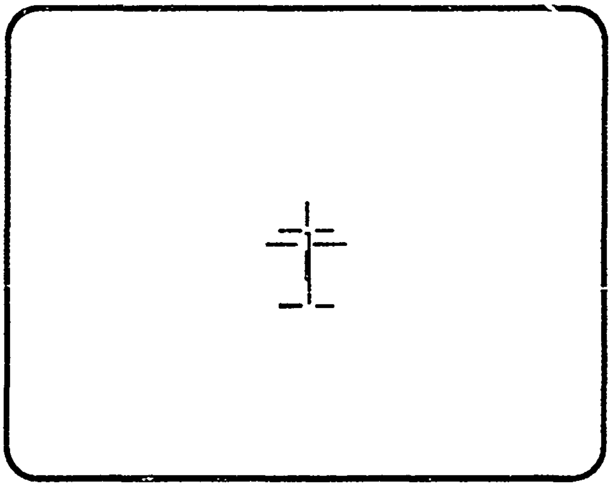
Press spacebar to see demonstration again.

The Rocket Steering Cursor is highlighted in green.



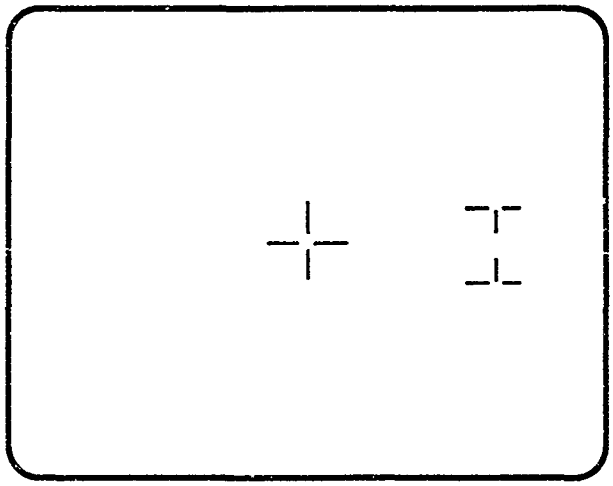
As shown in this display, the Rocket Steering Cursor and the LOS Reticle overlap when the pilot properly aligns the helicopter to fire the rockets.

The Rocket Steering Cursor is highlighted in green.



As shown in this display, the helicopter is in proper alignment for rocket engagement when any part of the vertical bar in the Rocket Steering Cursor is aligned with the center of the LOS Reticle.

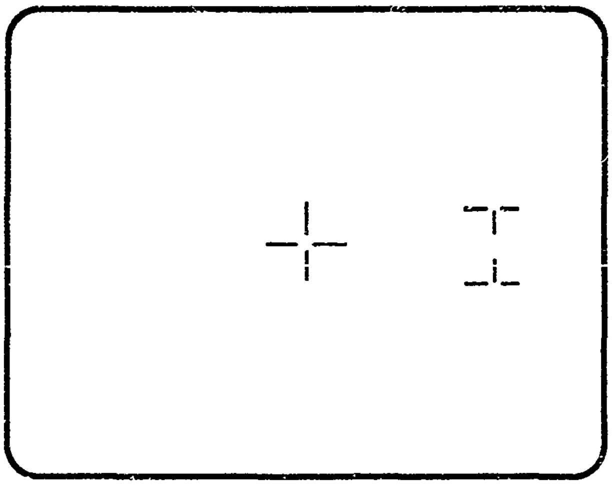
The Fixed Rocket Steering Cursor is highlighted in green.



This is the **Fixed Rocket Steering Cursor**.

It indicates the orientation required to align the helicopter into constraints for rocket engagements when the airspeed of the helicopter is greater than 100 knots.

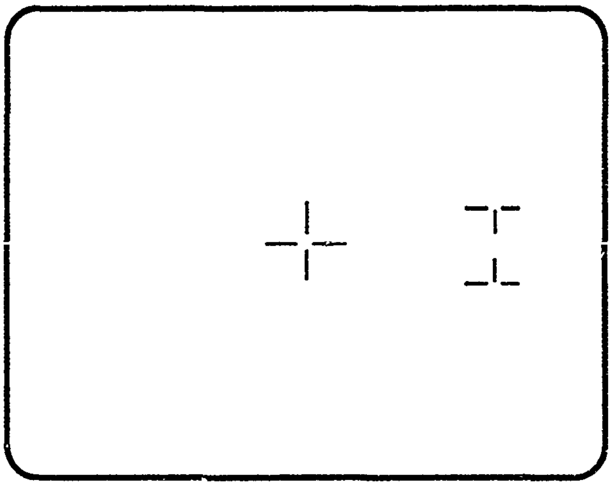
The Fixed Rocket Steering Cursor is highlighted in green.



The Fixed Rocket Steering Cursor is displayed to the pilot when:

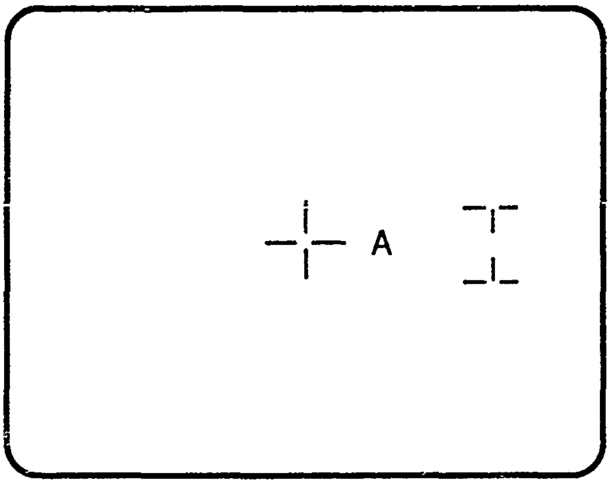
- either the pilot or the CPG has their respective RKT switch in the GND STOW position and action the rocket system,
- the crewmember actioning the rocket system has the RKT switch in NORM,
- the opposite crewmember's RKT switch is not in the GND STOW position, and
- the airspeed of the helicopter is 100 knots or more.

The Fixed Rocket Steering Cursor is highlighted in green.



As shown in this display, the location of the Rocket Steering Cursor indicates that the pilot should turn the helicopter (as represented by the LOS Reticle) to the right to be in constraints for using the rockets.

The Fixed Rocket Steering Cursor is highlighted in green. Letter is not shown.



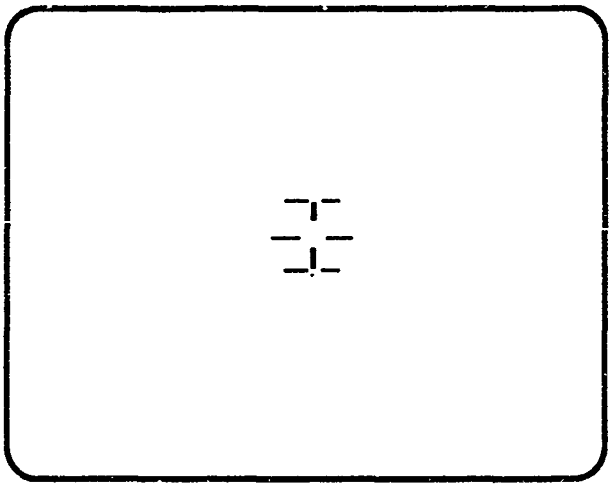
As the pilot turns the helicopter (represented by the LOS Reticle) to the right, the Fixed Rocket Steering Cursor moves to the left in the direction of the LOS Reticle, which remains stationary.

Press spacebar to simulate the pilot turning the helicopter to the right.

The Fixed Rocket Steering Cursor moves from its present position to position "A" in about 1 second.

Press spacebar to see demonstration again.

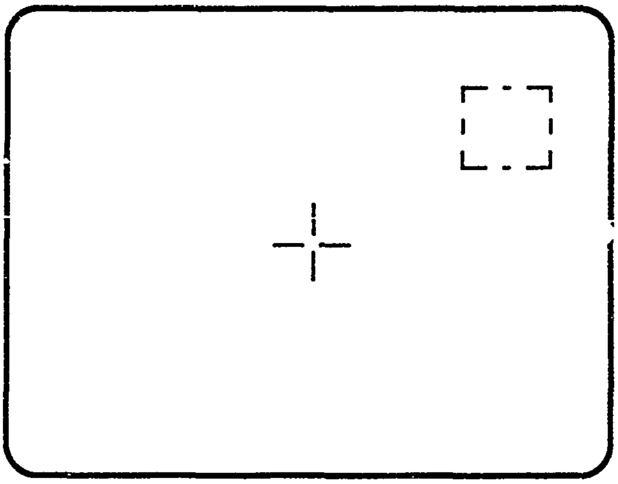
The Fixed Rocket Steering Cursor is highlighted in green.



As shown in this display, the Fixed Rocket Steering Cursor and the PNVS LOS Reticle overlap when the pilot properly aligns the helicopter to fire the rockets.

The open area in the middle of the Fixed Rocket Steering Cursor must be placed directly on the center of the LOS Reticle.

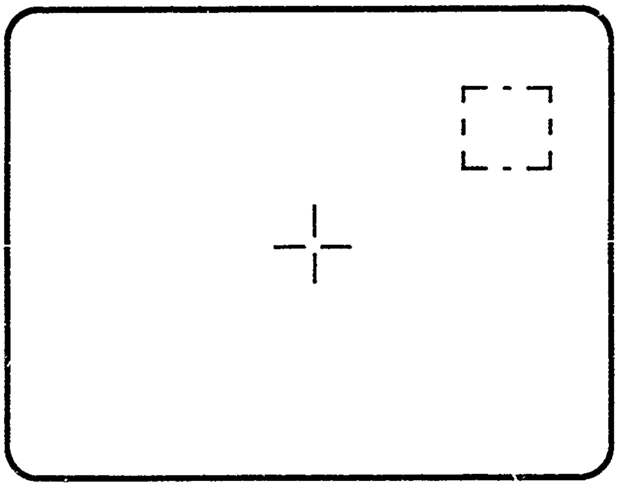
The Missile Constraints Box is highlighted in green.



This is the **Missile Constraints Box.**

It indicates the orientation required to align the helicopter (as represented by the LOS Reticle) into constraints for Hellfire missile engagements.

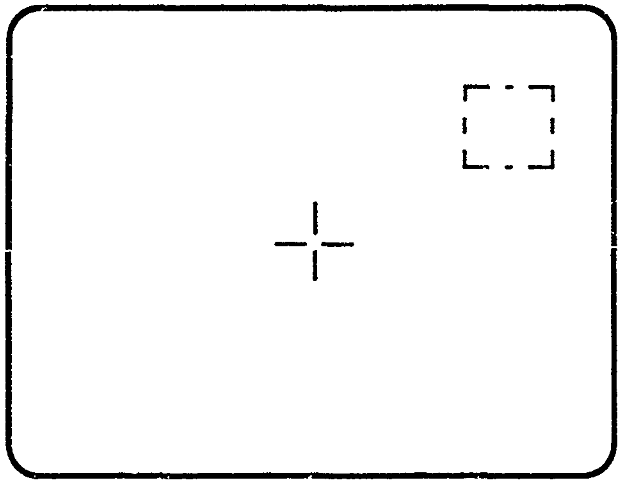
The Missile Constraints Box is highlighted in green.



A different size Missile Constraints Box is used to indicate:

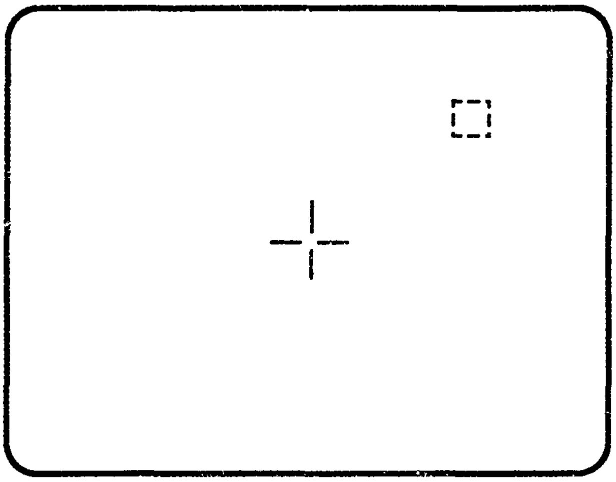
- A Lock-on-Before-Launch (LOBL) condition, and
- A Lock-on-After-Launch (LOAL) condition.

The Missile Constraints Box is highlighted in green.



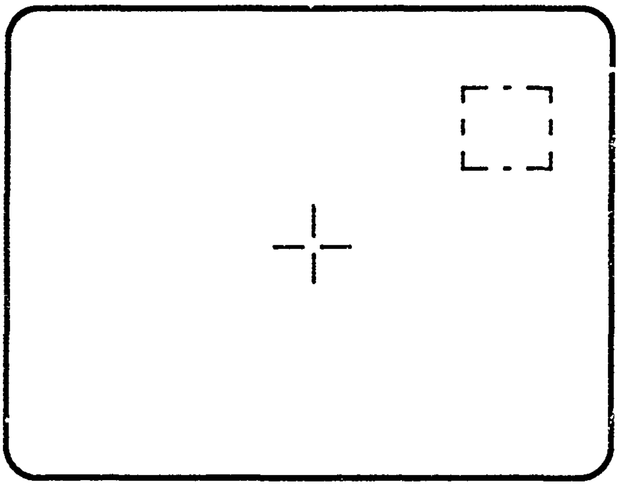
A large box is used to indicate a Lock-on-Before-Launch (LOBL) condition.

The Missile Constraints Box is highlighted in green.



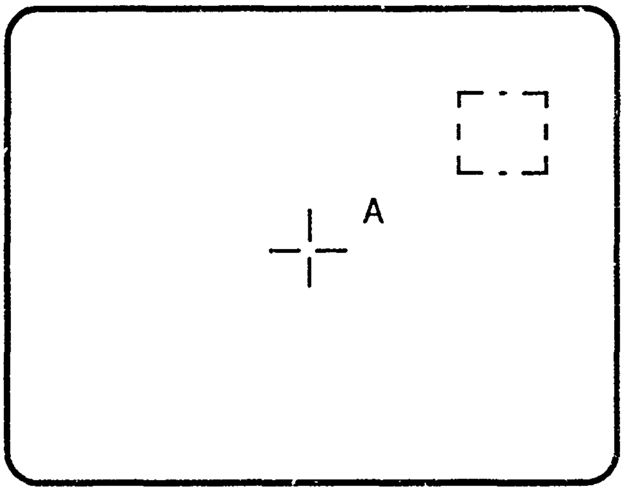
A small box is used to indicate a Lock-on-After-Launch (LOAL) condition.

The Missile Constraints Box is highlighted in green.



As shown in this display, the location of the Missile Constraints Box indicates that the pilot must move the helicopter up and to the right to be in constraints for Hellfire missile engagements.

The Missile Constraints Box is highlighted in green. Letter is not shown



As the pilot turns the helicopter (represented by the LOS Reticle) in the direction of the Missile Constraints Box, the box moves down and to the left in the direction of the LOS Reticle, which remains stationary.

When all constraints for missile engagement are satisfied, the box will change from dashed to solid.

Press spacebar for demonstration.

The Missile Constraints Box moves from its present position to position "A" in about 1 second. When the Missile Constraints Box reaches position "A", it changes from dashed to solid.

Press spacebar to see demonstration again.

You have now completed the lesson on Weapons Usage Symbols.

Please select what you would like to do now:

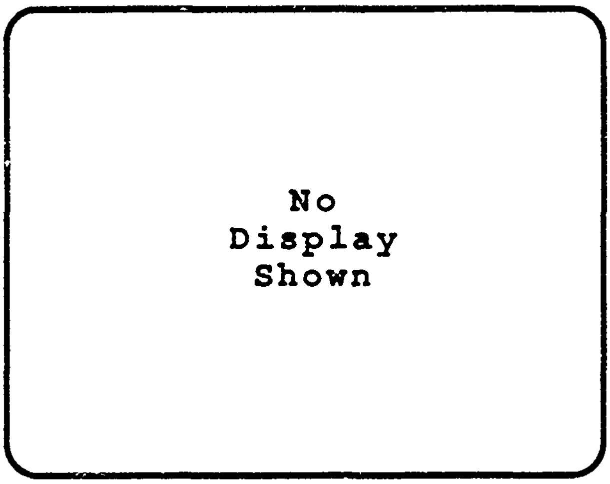
- Take the Quiz
- Return to the Main Menu

Symbology Tutor Quiz - Lesson 5: Weapons Usage Symbols

This quiz tests how much you learned about the Weapons Usage Symbols presented in Lesson 5. The quiz consists of 15 multiple choice questions. Each answer has a small box associated with it. You will see a cross-shaped pointer just below the question and above the answer boxes. Use the arrow keys on the Numeric KeyPad to move the pointer to the box next to your answer, then press ENTER to confirm your answer. You must answer each question correctly one time before you may leave the quiz.

Press ENTER to begin the quiz.

V-Q1



The Cued LOS Reticle represents the computed rounds impact point for the gun when the pilot:

1) places the ACQ SEL switch in the ON position
2) places the GUN switch in the FXD position
3) actions the gun system with the Master switch in the OFF position
4) places the Sight Select Switch in the HMD position

Correct answer = 2. If response = 1, 3, or 4, go to V-T1.

No Display Shown

The Rocket Steering Cursor indicates the orientation required to align the helicopter into constraints for rocket engagement when:
1) the pilot places the ACQ SEL switch in the ON position
2) the pilot places the Sight Select Switch in the HMD position
3) the airspeed of the helicopter is less than 100 knots
4) the airspeed of the helicopter is more than 100 knots

Correct answer = 3. If response = 1, 2, or 4, go to V-T2.

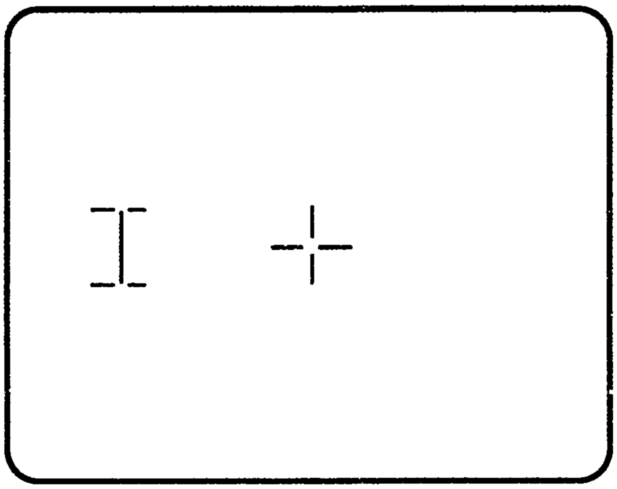
V-Q3

No
Display
Shown

Which of the following conditions will <u>not</u> allow the Rocket Steering Cursor to be displayed to the pilot:

1) either the pilot or the CPG actions the rocket system
2) at least one crewmember has the RKT switch (on the FCC panel) in the NORM position
3) the airspeed of the helicopter is less than 100 knots
4) the opposite crewmember's RKT switch is in the GND STOW position

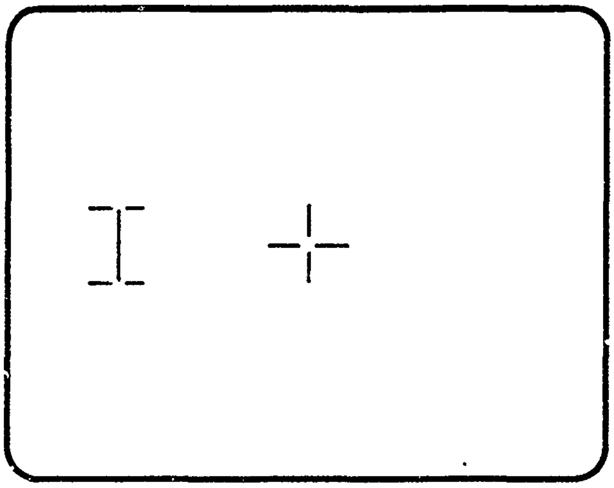
Correct answer = 4. If response = 1, 2, or 3, go to V-T3.



As shown in this display, the location of the Rocket Steering Cursor indicates that the pilot should take what action to be in constraints for using the rockets?

1) turn the helicopter directly to the left
2) turn the helicopter directly to the right
3) turn the helicopter upward and to the left
4) turn the helicopter downward and to the right

Correct answer = 1. If response = 2, 3, or 4, go to V-T4.



As shown in this display, when the pilot aligns the helicopter into constraints for rocket engagements:

1) the Rocket Steering Cursor remains stationary and the LOS Reticle moves to the left
2) the LOS reticle remains stationary and the Rocket Steering Cursor moves to the right
3) the Rocket Steering Cursor remains stationary and the LOS Reticle moves to the right
4) the LOS reticle remains stationary and the Rocket Steering Cursor moves to the left

Correct answer = 2. If response = 1, 3, or 4, go to V-T5.

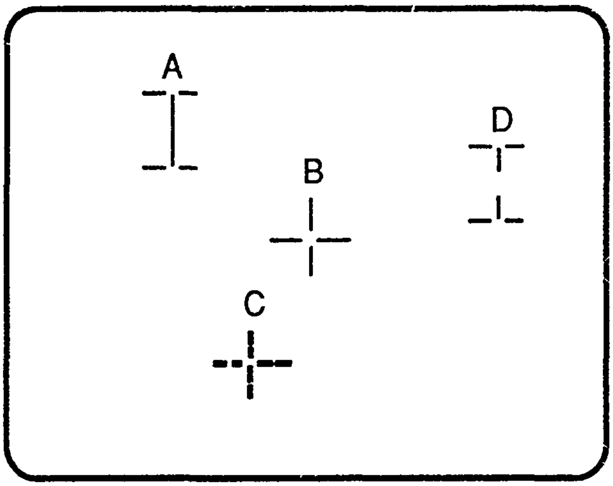
V-Q6

**No
Display
Shown**

When the pilot properly aligns the helicopter to fire the rockets:
1) the Rocket Steering Cursor disappears from the display
2) the Rocket Steering Cursor flashes at a one hertz rate
3) the Rocket Steering Cursor turns from dashed to solid
4) some part of the vertical bar in the Rocket Steering Cursor aligns with the center of the LOS Reticle

Correct answer = 4. If response = 1, 2, or 3, go to V-T6.

Letters are shown in blue.



The symbol shown as position "D" in this display is the:
1) Rocket Steering Cursor
2) Fixed Rocket Steering Cursor
3) LOS Reticle
4) Cued LOS Reticle

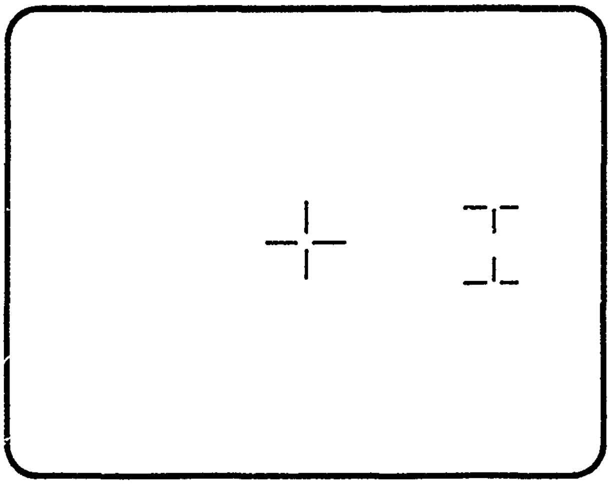
Correct answer = 2. If response = 1, go to V-T2 V-T8; if 3 or 4, go to V-T8.

No Display Shown

Which of the following conditions will not allow the Fixed Rocket Steering Cursor to be displayed to the pilot?

1) either the pilot or the CPG have their respective RKT switch in the GND STOW position and action the rocket system
2) the crewmember actioning the rocket system has the RKT switch in NORM
3) the opposite crewmember's RKT switch is not in GND STOW
4) the airspeed of the helicopter is less than 100 knots

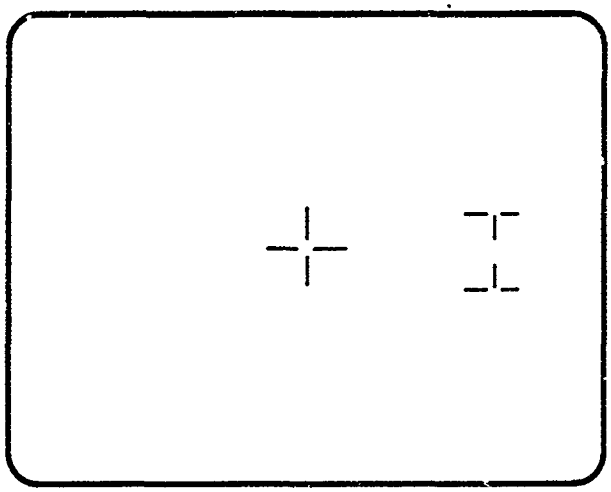
Correct answer = 4. If response = 1, 2, or 3, go to V-T9.



As shown in this display, the location of the Fixed Rocket Steering Cursor indicates that the pilot should take what action to be in constraints for using the rockets?

1) turn the helicopter directly to the left
2) turn the helicopter directly to the right
3) turn the helicopter upward and to the left
4) turn the helicopter downward and to the right

Correct answer = 2. If response = 1, 3, or 4, go to V-T10.



As shown in this display, when the pilot aligns the helicopter into constraints for rocket engagements:

1) the Fixed Rocket Steering Cursor remains stationary and the LOS Reticle moves to the left
2) the LOS reticle remains stationary and the Fixed Rocket Steering Cursor moves to the right
3) the Fixed Rocket Steering Cursor remains stationary and the LOS Reticle moves to the right
4) the LOS reticle remains stationary and the Rocket Fixed Steering Cursor moves to the left

Correct answer = 4. If response = 1, 2, or 3, go to V-T11.

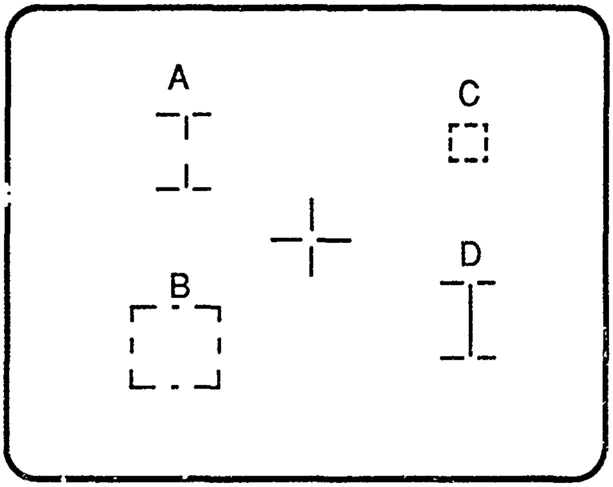
No
Display
Shown

When the pilot properly aligns the helicopter to fire the rockets:

1) the Fixed Rocket Steering Cursor disappears from the display
2) the Fixed Rocket Steering Cursor turns from dashed to solid
3) only the open part of the Fixed Rocket Steering Cursor aligns with the center of the LOS Reticle
4) only the solid part of the vertical bar in the Fixed Rocket Steering Cursor aligns with the center of the LOS Reticle

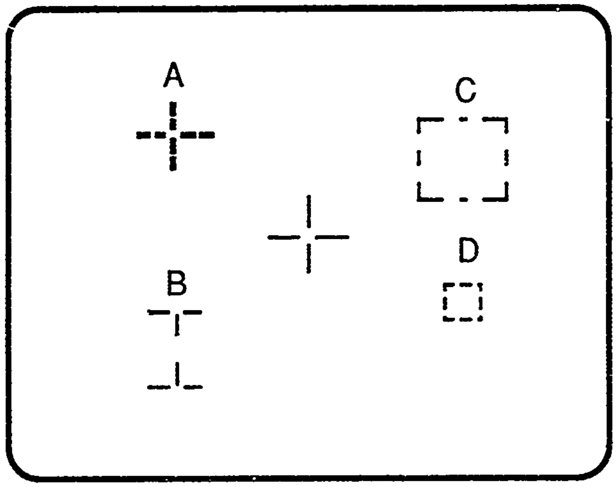
Correct answer = 3. If response = 1, 2, or 4, go to V-T12

Letters are shown in blue.



Which of the symbols shown in this display would the pilot use to align the helicopter for missile engagements in a Lock-on-Before-Launch (LOBL) condition?
1) Symbol "A"
2) Symbol "B"
3) Symbol "C"
4) Symbol "D"

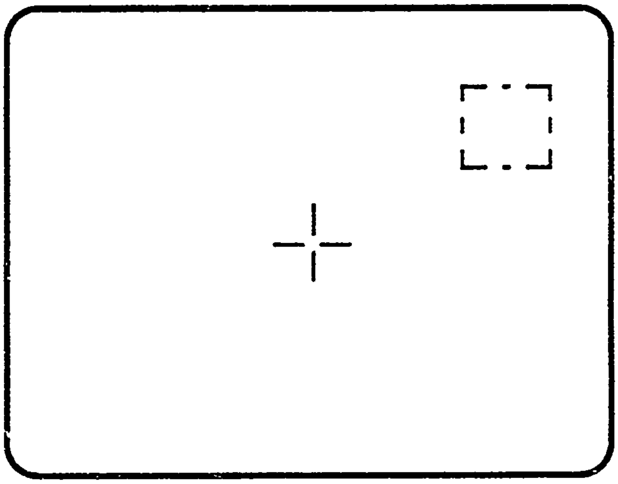
Correct answer = 2. If response = 1, 3, or 4, go to V-T15.



Which of the symbols shown in this display would the pilot use to align the helicopter for missile engagements in a Lock-on-After-Launch (LOAL) condition?

1) Symbol "A"
2) Symbol "B"
3) Symbol "C"
4) Symbol "D"

Correct answer = 4. If response = 1, 2, or 3, go to V-T16.



As shown in this display, the location of the Missile Constraints Box indicates that the pilot must move the helicopter in what direction to be in constraints for missile engagement?

1) upward and to the left
2) upward and to the right
3) downward and to the left
4) downward and to the right

Correct answer = 2. If response = 1, 3, or 4, go to V-T17.

No
Display
Shown

When all constraints for missile engagement are satisfied, the Missile Constraints Box:

1) disappears from the display
2) flashes at a one hertz rate
3) changes from dashed to solid
4) aligns with the Rocket Steering Cursor

Correct answer = 3. If response = 1, 2, or 4, go to V-T18.